ECONOMIC ASSESSMENT FOR THE NECEDAH NATIONAL WILDLIFE REFUGE COMPREHENSIVE CONSERVATION PLAN

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INTRODUCTION CHAPTER 1

The objective of this report is to provide an estimate of the regional economic and national social welfare impacts of the Necedah National Wildlife Refuge (NNWR). This analysis is intended to support, and eventually will become part of, a larger Comprehensive Conservation Plan (CCP) that will serve as a guide for NNWR management over the next 10 to 15 years. In order for management to successfully guide the NNWR they need to have information as to how the decisions they make affect both the local economy and national economic welfare now and in the future. This report is intended to provide that information.

The existence of the NNWR has direct economic impacts on the local economy. A variety of commercial activities take place within the NNWR, including timber harvesting and trapping for pelts. In addition, several of the surrounding towns maintain roadways that pass through the NNWR. The NNWR has an annual budget that supports employee salaries, operations and maintenance costs and educational programs. The Refuge is sometimes allocated funding for capital improvements such as building bridges, dams and roads. All of these activities have effects on the local economy.

The NNWR also has an indirect economic impact on the local economy through the many recreational activities that it supports. These activities include hunting, fishing, wildlife viewing, photography, berry picking, hiking and cross-country skiing. Although the NNWR charges no entrance fee, individuals that visit the refuge and participate in these activities purchase a variety of goods and services in the towns surrounding the Refuge (e.g., food, lodging, fuel, equipment), and thus contribute to the health of the regional economy.

In this report, we analyze the regional economic contribution of the NNWR under several different scenarios. First, the economic impacts of commercial and recreational activities that take place within the existing boundaries of the NNWR are estimated using a regional input/output model

called IMPLAN. Considered are the current, or "baseline" (i.e., 1996), economic impacts, as well as impacts 15 years in the future and 30 years in the future. Second, we estimate the regional economic impacts that would be associated with expansion of the NNWR. Specifically, we consider a scenario under which the NNWR would restore and preserve lands adjacent to the east of the current boundary to form an area of up to 18,100 acres (hereafter referred to as the "focus area"). Because the time frame over which this expansion would occur is not currently known, and because the specific parcels that would be acquired (if any) for addition to the NNWR are also unknown, we present the results on this analysis in the form of two "acre-use" metrics. The first metric reports the economic impact associated with the conversion of a parcel of land currently in a specific use category (e.g., potato farming) to Refuge lands. The second metric reports the economic impact associated with the conversion of a parcel of land in the focus area from an "average" use (reflecting the current mix of land uses in this area) to Refuge lands.

In addition to the contribution of commercial and recreational activities to the regional economy, the NNWR provides for the generation of national economic welfare, or consumer surplus benefits. Consumer surplus represents the amount an individual would be willing to pay for a good or service over and above the asking price. In the case of recreational activities, individuals are often able to enjoy these activities at a price that is less than the amount they would be willing to pay. Thus, economic welfare measures capture the added benefit consumers gain beyond that reflected in the dollar value of goods and services purchased in the process of participating in these activities, as incorporated in the regional economic analysis. Economists have developed a variety of methodologies to estimate surplus values associated with various recreational activities and environmental goods, and research applying these methodologies is widely reported on in the literature. This report relies on these existing welfare estimates to provide a measure of the social welfare value of the NNWR under both baseline conditions (i.e., as the NNWR exists today), and under the expansion scenario.

Finally, the NNWR's principal mission is to provide ecological services to wildlife such as a protected habitat and source of food. The lands that make up the NNWR support an array of species, some of which state and federal agencies list as threatened or declining. Some of these threats are associated with increased commercial (including agricultural) activity, as well as the demands of an increasing regional population. In this report we utilize the existing literature to provide an order-of-magnitude estimate of the value of the ecological services provided by the NNWR.

ORGANIZATION OF THE REPORT

The remaining chapters of this report are organized as follows:

- In Chapter 2, we define the geographic area of interest and provide an overview of the regional economy. Some basic demographic, economic and socioeconomic data are listed along with the commercial and recreational activities that take place on the NNWR. A discussion is provided on the proposed focus area.

- In Chapter 3, we provide background on the analytical approach used in the regional economic analysis, including an overview of the regional input/output model applied to this analysis (i.e., IMPLAN). In this chapter we report our estimate of the current regional economic contribution of the NNWR in its existing state, along with estimated economic impacts 15 and 30 years in the future.

- In Chapter 4, we discuss the analytic method used to estimate the regional economic impacts that would result from NNWR acquiring land within the proposed Yellow River focus area. We provide a discussion of the acre-use metrics used in the analysis. We then summarize the results of our use of IMPLAN to estimate the regional economic impacts of the NNWR acquiring lands in the base year and 15 and 30 years in the future. We also describe the lost tax revenue associated with a current and future acquisition, and provide estimates of the contribution of increased NNWR recreation on focus area lands.

- In Chapter 5, we address the economic surplus provided by the NNWR under both current conditions and under the proposed expansion scenario. We provide a framework for assessing the economic surplus that visitors receive by participating in recreational opportunities at the NNWR and in the focus area. In addition, we provide an analysis of the value of ecological services, such as habitat protection, provided by the existing NNWR and the focus area.

- At the end of the report, we provide a bibliography of sources used.

OVERVIEW OF THE REGION AND THE NNWR CHAPTER 2

As context for the analysis that we present in Chapters 3 through 5, this chapter provides an overview of the regional economy and the NNWR. In particular, in this chapter we discuss:

- The regional economy in which the NNWR operates, including economic, demographic and socioeconomic characteristics;
- The history of the NNWR, its purpose and its mission;
- The commercial activities that occur on the NNWR and their associated values;
- The recreational activities that take place on the NNWR;
- Possible threats to the Refuge in continuing its mission; and
- The proposed focus area, including possible acquisition scenarios.

THE REGION

South-central Wisconsin is marked by low-lying hills, lakes and rivers, forests, pasture and agricultural lands. The region of specific interest for this study includes four counties: Adams, Juneau, Monroe and Wood. Exhibit 2-1 shows the Refuge, the proposed Yellow River Focus Area, nearby towns, and other nearby recreation areas.

The study region is less densely populated than Wisconsin as a whole, and has exhibited modest population growth over the last decade. The natural landscape, rural character and availability of local recreational opportunities have attracted retirees and others from urban areas in Wisconsin and bordering states. Exhibit 2-2 provides area and population statistics for the

four counties that make up the study area. The population growth rate for these counties from 1990 to 1995 is approximately equal to that of the State of Wisconsin as a whole, but less than that for the entire U.S. over this time period.[1]

Exhibit 2-2

AREA AND POPULATION OF THE FOUR-COUNTY REGION

Area:	3,110 square miles 1,990,400 acres
Population:	147,570 in 1990 154,540 in 1995
Percentage Growth, 1990-1995	4.7%
Source: *County Economic Profile*, Department of Commerce, Madison, WI.	

Exhibit 2-3 reports population projections for the State of Wisconsin and the four counties for selected years. Note that the population of counties in the study area is expected to grow at a rate less than that of the State of Wisconsin as a whole over the next 30 years (approximately 2.6 percent for the study area versus 7.3 percent for the state by 2030).

Exhibit 2-3

POPULATION PROJECTIONS FOR THE STATE OF WISCONSIN AND FOUR COUNTIES IN STUDY AREA FOR SELECTED YEARS

Region	2000	2010	2020
Adams County	18,265	18,423	17,562
Juneau County	23,322	23,785	23,661
Monroe County	39,384	40,621	41,238
Wood County	77,427	79,211	80,077
State of Wisconsin	5,287,825	5,512,313	5,676,793
Source: Demographic Services Center, *http://www.doa.state.wi.us/deir/queries/pproj4.idc*.			

Exhibit 2-4 reports the number of employed persons by industry for each county in the study area, and for the region as a whole. A few large manufacturing industries contribute significant employment to the region. In addition, services such as hospitals and retail establishments also provide many employment opportunities.

[1] Population growth in the U.S. from 1990 to 1995 was approximately 5.4 percent.

Exhibit 2-4

EMPLOYMENT BY INDUSTRY AND COUNTY (1992)

Industry	County				Total
	Adams	Juneau	Monroe	Wood	
Mining	0	0	10	0	10
Construction	221	547	726	2,240	3,734
Manufacturing	511	2,888	2,956	10,314	16,669
Transportation & Public Utilities	242	378	1,127	3,125	4,872
Trade	0	2,333	3,689	10,805	16,827
Services	1,167	2,379	4,422	15,051	23,019
Government	1,084	1,674	4,923	4,672	12,353
Agriculture [1]	429	938	2,110	1,640	5,117

[1] Data are for 1990 and include forestry.

Sources: *County Economic Profile*, Department of Commerce, Madison, WI; *County and City Data Book*, 1994, U.S. Dept. of Commerce.

In the immediate area around the Refuge, however, agricultural activities constitute the most important component of the regional economy. This sector includes both dairy farms and farms that grow row crops (e.g., sweet corn, potato, snap beans). Cranberry production is important to the region, and is considered a premium crop in that it commands a high price in the market.[2] Cranberry beds, while representing a small percentage of the total land area, are scattered throughout the region. Because the region has large tracts of both private and public forest land, the timber industry is important to the regional economy as well. Exhibit 2-5 provides some summary agricultural statistics.

[2] In 1996 Wisconsin surpassed Massachusetts to become the largest producer of cranberries in the U.S.

Exhibit 2-5

AGRICULTURAL STATISTICS FOR THE FOUR COUNTY ECONOMIC REGION (1992)

	County				
	Adams	**Juneau**	**Monroe**	**Wood**	**Total**
Number of Farms	340	675	1,549	1,029	3,593
Land in Farms (acres)	119,354	195,287	346,398	221,357	882,396
Average Size Farm (acres)	351	289	224	215	246
Total Value of Products (millions)	$40	$56	$96	$83	$275

Sources: *County Economic Profile*, Department of Commerce, Madison, WI; *1997 County and City Extra, Annual Metro, City and County Data Book*, Bernan Press, Lanham, MD.

Exhibit 2-6 provides the per capita income figures for each of the four counties. Within the region, Wood County is the most populous and the strongest economically.

Exhibit 2-6

PER CAPITA INCOME BY COUNTY (1994)

County	**Income**
Adams	$13,567
Juneau	$15,665
Monroe	$14,720
Wood	$21,299

Source: *1997 County and City Extra, Annual Metro, City and County Data Book*, Bernan Press, Lanham, MD.

The four counties that make up the study area offer a variety of recreational activities on both public and private lands. Along with the NNWR, there are several other public recreation areas. These include Sandhill Wildlife Area (about 20 miles north of the NNWR in Wood County), Wood County Wildlife Area and Meadow Valley Wildlife Area. These areas offer substitute sites and opportunities to the NNWR for hunting, fishing, wildlife viewing, photography and other recreational activities.

THE NECEDAH NATIONAL WILDLIFE REFUGE

The NNWR was established in 1939 and currently incorporates about 43,655 acres of land. Prior to 1939 most of the lands that now make up the Refuge were farmed. However, the low-lying character of this land made it a poor choice for agriculture, and many of these farms eventually failed. The federal government purchased much of the land that makes up the NNWR under the Jones-Bankhead Farm Tenant Act with the intent of establishing a wildlife refuge.

Formal establishment of the NNWR included a long-range plan to restore the land to productive wildlife habitat. As with other national wildlife refuges, the primary purpose of the NNWR is to provide "a refuge and breeding ground for migratory birds and other wildlife."[3] The Refuge offers a sanctuary for a number of species including several species of waterfowl and migratory songbirds, wild turkey, ruffed grouse, white-tailed deer, beaver, raccoon, mink, otter, coyote, skunk, muskrat, cotton tail rabbit, snowshoe hare and red, gray, and fox squirrels. The Refuge also protects certain endangered and threatened species, such as the Karner blue butterfly, Blanding's turtle, massasauga rattlesnake, wolf and bald eagle. Managers of the NNWR have sought to restore and maintain rare and ecologically important oak barrens located on the Refuge.

Commercial Activity

Several commercial activities occur on the Refuge:[4]

- The annual budget accounts for staff salaries, maintenance and operations, small capital purchases and educational programs of the NNWR. The Refuge employs a staff of 11 permanent employees and one to three temporary employees, with a total budget of $624,200 in 1996.[5]

- Each year certain sections of the NNWR are selected for timber harvesting. Timber is selectively marked and cut to maintain quality habitat. However, most of the timber harvested is of relatively low quality. During the 1996-97 season, 3,237 cords of wood were taken with a value of $153,758.[6]

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[3] *Necedah National Wildlife Refuge*, FWS fact sheet.

[4] For the purposes of implementing the IMPLAN model, the Refuge's annual budget, revenues from timber harvests, budgets for road maintenance and revenues from trapping are all considered part of the region's commercial activity sector.

[5] *Necedah National Wildlife Refuge*, FWS fact sheet.

[6] Personal communication with Larry Wargowsky, NNWR manager, August 28, 1997.

- Species trapped on the NNWR include mink, beaver, muskrat and raccoon. The annual average value of pelts taken over a 16-year period (1980 to 1995) was $6,858.[7]

- In addition to the maintenance of lands by the U.S. Fish and Wildlife Service (FWS), certain roads within the boundaries of the NNWR are maintained by the surrounding towns of Necedah, Finley, Cutler and Kingston. These towns spend, on average, approximately $96,000 annually (in 1996 dollars) for road maintenance, with a large component of this cost for snow removal.[8]

The economic values of these commercial activities are summarized in Exhibit 2-7. The regional economic contribution of each of these activities is estimated in Chapter 3.

Exhibit 2-7

1996 COMMERCIAL ACTIVITY VALUES OF THE NNWR (1996$)

Activity	Value
Refuge Budget	$624,200
Road Maintenance	$96,000
Timber Sales	$153,758
Trapping Sales	$6,858

Sources: NNWR management; Town Chairpersons of Necedah, Cutler, Finley and Kingston.

Recreational Activity

Necedah National Wildlife Refuge offers a variety of recreational opportunities, including but not limited to hunting, fishing and wildlife viewing. Although the NNWR is open to the public all year, most visitation occurs in the summer and fall. The hunting season includes the fall, winter and spring, and fishing is allowed in certain sections of the Refuge in all seasons.

[7] Data provided by Refuge management; value estimated by IEc.

[8] This value can increase in some years based on special grants from the state government for road improvements. Special grants were not included in the estimates presented here or used in the IMPLAN model. Telephone conversation with town managers, September 1997.

Approximately 60 percent of the Refuge is closed to most public activities to minimize disturbance to migratory birds.[9] Consumptive recreational activities on the NNWR include the following:[10]

- Hunting for both large game (white-tailed deer) and small game species (gray and fox squirrel, rabbit, snowshoe hare, ruffed grouse and raccoon).[11]
- Waterfowl hunting in the fall and wild turkey hunting in the spring and fall.
- Fishing on Refuge waters, primarily for northern pike and bullheads (less frequently fished species include black crappie, yellow perch and sunfish).[12]
- Blueberry and red raspberry picking during the summer season.
- Gathering of firewood (with a five dollar permit).

The most common non-consumptive activity is wildlife viewing. Logbook records in the visitor contact area indicate that people from all over the world come to the NNWR to observe native and migratory species; in fact, most visitors live outside the local area.[13] The Refuge offers wildlife auto routes, with parking areas at points of interest and observation towers for more expansive views. Environmental education opportunities are provided through the visitor contact area and in the form of placards along the auto route and trails. In addition, the NNWR offers other activities such as hiking on established roads and trails in the summer and snowshoeing and cross-country skiing in the winter. In July, visitors have the opportunity to walk and pick berries through the entire, extensive forest habitat of pine, oak and aspen.

Exhibit 2-8 summarizes 1996 expenditure data for recreational trips taken to the NNWR. Reported expenditures per trip are based on the *1991 National Survey of Fishing, Hunting, and*

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[9] Refuge personnel were not able to provide details on the characteristics of the closed portions of the Refuge.

[10] *Necedah National Wildlife Refuge*, FWS fact sheet.

[11] Hunting of deer is only permitted in specific zones of the NNWR during the 10-day state deer gun hunting season. During this time no other public use activities take place on the Refuge. Small game are hunted from the end of the deer season through February.

[12] The NNWR allows use of non-motorized and motorized boats within certain areas of the Refuge during prescribed times.

[13] Visitor statistics do not contain sufficient detail to enable a characterization of the demographics of NNWR recreationalists.

Wildlife Associated Recreation, developed by FWS (converted to 1996 dollars). These expenditure estimates reflect expected state-wide averages, and are not based on survey data or other primary data from users of this specific Refuge. As with the commercial activity values, the importance of the recreational expenditures is not only in the direct effects but also the indirect and induced regional economic effects, described in Chapter 3.

Exhibit 2-8

RECREATIONAL ACTIVITY EXPENDITURES ON THE NNWR

	Average Expenditures per Recreation Day (1996 $)		
Expenditure Category	**Fishing**	**Hunting**	**Wildlife Viewing**
Food	$9.39	$7.01	$6.61
Lodging	$3.43	$2.56	$1.41
Equipment	$8.10	$15.73	$1.35
Transportation	$6.85	$5.09	$6.08
Boating Expenses	$2.94	N/A	N/A
Ice and Bait	$2.29	N/A	N/A
TOTAL	$33.00	$30.39	$15.45

Source: FWS, *1991 National Survey of Fishing, Hunting, and Wildlife Associated Recreation.*

In 1996, the NNWR supported an estimated 7,325 fishing days, 9,230 hunting days and 106,835 wildlife viewing days. Activity trips are drawn from tallies developed by NNWR managers and reported in the Refuge Management Information System (RMIS).

Caveats On the Activity Data

The data on NNWR commercial and recreational activity have associated with them varying levels of certainty. In general, the commercial activity estimates are more certain than the recreational estimates. For example, the NNWR budget for 1996 has already been established, and the timber and pelt output estimates are based on market values and actual revenue averages.

The estimates of recreation days are more uncertain, however, since a variety of approaches were used to collect these data. NNWR management places emphasis on the development of a precise estimate of hunting activity on the Refuge, while counts of the number of recreational anglers are more sporadic. Therefore, the true number of fishing trips is known with less certainty.

To estimate the number of wildlife viewing days, Refuge management use substantial professional judgment to fill in data gaps. These estimates, obtained from RMIS, required significant interpretation. In particular, they contained some double-counting among various types of nonconsumptive recreation. For example, a visitor who drives the auto tour route and hikes a nature trail would be counted as a participant in each of these activities. By removing fishing and hunting days

from the total, we arrived as a smaller, but still upper-bound, estimate. In sum, the level of precision in these data simply do not allow for an accurate estimate of annual wildlife viewing days.

Threats To The Refuge

The lands that currently make up the NNWR were set aside to offer habitat and provide food for migrating waterfowl and native species. This has been the principle mission of the NNWR over the last five decades. While the character of the NNWR has changed little since it was established, the area surrounding the Refuge has changed considerably. Some of these changes have come in the agricultural sector. For example, agriculture in the region has become more dependent on applications of pesticides and fertilizers. Runoff from farm fields can eventually end up in the canals, lakes, ponds, shallows and streams of the NNWR, posing a threat to wildlife and the habitats on which they rely.[14]

The growth of the regional cranberry industry, which occurred relatively slowly until the increase in consumer demand for cranberry products in the early 1970s, represents another possible threat to the NNWR. The Wisconsin cranberry crop has a total annual market value in excess of $100 million.[15] The counties surrounding the NNWR all contain cranberry beds, with the largest number of acres planted with this crop in Wood County, north of the Refuge. Like other agricultural crops, cranberry beds are sprayed intensively with a variety of pesticides and fertilizers, which may eventually work their way into the main water channels supplying the Refuge. Cranberry beds recently developed near the Refuge are also competing for water supplies serving the Refuge. [16]

Cranberry beds are best suited for low lying wet or moist ground. However, this is also the very type of land that supports productive wildlife habitat.[17] Although land presently in the NNWR cannot be sold or leased for cranberry production, land adjacent to the Refuge's borders may be sold for this purpose. This encroachment on the borders of the Refuge can have a detrimental effect on the quality of the habitat and the survival of wildlife. Currently, an estimated 200 acres of cranberry beds

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[14] Personal communication with Refuge management, August 1997.

[15] Wisconsin Department of Agriculture, Trade, and Consumer Protection, *Wisconsin Agricultural Statistics, 1997.*

[16] Personal communication with Refuge management, August 1997.

[17] Personal communication with Refuge management, August 1997.

per year are being developed near the boundaries of the Refuge. The total acreage of cranberry beds currently in Juneau and Wood counties is estimated to be 4,500.[18]

Potato growing also represents a potential threat to the Refuge. Potato fields are plentiful in the area surrounding the Refuge; approximately 3,700 acres are planted in Juneau and Wood counties combined.[19] The potato crop, perhaps even more than the cranberry crop, requires extensive application of pesticides and fertilizers.[20] However, potato production is not expanding as rapidly as cranberry production. Whereas potatoes are a commodity crop grown practically everywhere in the U.S. and exhibit stable market demand, cranberries are a premium crop grown in only about five states that have an increasing world-wide demand. Therefore, a significant increase in the number of acres of potatoes planted in the near future appears unlikely.[21]

Increasing population in the region represents a small but persistent threat to the NNWR. As noted earlier in this chapter, the population of the four county region surrounding the Refuge has increased slowly over the past decade, and is expected to continue to rise slowly. These population increases could strain the region's water resources. As mentioned above, the availability of a variety of public and private recreational areas has attracted many of the new residents. Developers are buying land and parceling out areas for trailers and mobile homes.[22] Most of the acreage being transformed for residential use is currently forest land, with the remainder from a mix of lands that are, in general, no longer being farmed.[23]

The Wisconsin Air National Guard maintains a gunnery and bombing training range, the Hardwood Air-to-Surface Gunnery, just northeast of the NNWR. According to Refuge management, an expansion of this range could have a significant effect on the Refuge, especially on native wildlife and

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[18] Personal communications with Juneau and Wood County Agricultural Extension Office personnel, September 1997.

[19] Personal communications with Juneau and Wood County Agricultural Extension Office personnel, September 1997.

[20] Personal communications with Juneau and Wood County Agricultural Extension Office personnel, September 1997.

[21] Personal communications with Juneau and Wood County Agricultural Extension Office personnel, September 1997.

[22] Personal communications with Refuge management and local assessors, August and September 1997.

[23] Personal communications with local assessors, September 1997.

migrating bird populations. Although the local community appears to be opposed to such expansion, further development of the range remains uncertain.[24]

The Proposed Yellow River Focus Area

To mitigate the encroachment on the Refuge by agriculture, new residences and other influences, the management of the Refuge is evaluating the feasibility of restoring and preserving habitat within a strip of land east of the Refuge border known as the Yellow River Focus Area (YRFA). This area contains about 18,100 acres, is approximately 22 miles long, and averages nearly a mile wide. The strip encompasses the Yellow River.

The area provides a valuable breeding habitat for a wide variety of wildlife, particularly neotropical migratory birds and waterfowl. It is also an important corridor for migratory species through central Wisconsin. Preservation of this land would enhance the viability of several important species, including the Karner blue butterfly, Blanding's turtle, red-shouldered hawk and the eastern massasauga rattlesnake. Bald eagles and great blue herons have bred in this area for the past several years. Other animal species found in the proposed focus area include the glass lizard, wood thrush, cerulean warbler, scarlet tanager, blue-winged warbler, woodcock, wild turkey, ruffed grouse, white-tailed deer, and fox and gray squirrel.[25]

The Yellow River watershed is characterized by near-level topography and sandy soils. The river area contains a low stream gradient with many oxbows, cut-off and running sloughs and small ponds. The watershed is home to a predominant plant community of floodplain forest, i.e., bottomland hardwoods, and supports silver maple, green ash, swamp white oak and river birch. Sandy ridges support white oak, Hill's oak, black cherry, white pine and some red pine.[26]

The Refuge plans to restore and preserve this area through a variety of voluntary partnerships, easements and land acquisition. These three options, described below, may be exercised singly or in conjunction with each other:

- The preferred option involves developing written cooperative agreements specifying land use practices sensitive to the needs of FWS trust resources with willing landowners within this area. This low (or no) cost option is

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[24] Personal communications with local assessors, September 1997.

[25] U.S. FWS, *Preliminary Project Proposal Summary*, January 1995.

[26] U.S. FWS, *Preliminary Project Proposal Summary*, January 1995.

the least difficult of the three to implement. However, because the agreements are not legally binding, the long-run effect on land within the area is uncertain.

- The next preferred option involves the Refuge purchasing easements on land within the YRFA to encourage certain land uses. Such easements likely would preclude commercial agricultural activity in sensitive areas. The costs of this option are higher than the cooperative agreement option because developing appropriate easements can take several years. However, purchasing easements may be worth the level of effort required because they constitute enforceable agreements.

- The least preferred option involves the outright purchase of the land (fee title ownership). Although this option ensures that the Refuge manages the land in perpetuity, the cost may be prohibitive (nearly nine million dollars ($1997)).[27] Funding uncertainties make plans for fee title acquisition difficult.

Preservation of the YRFA appears to enjoy wide support. The Wisconsin Department of Natural Resources (DNR) has identified the entire Yellow River watershed as significantly important for wildlife resources and supports the FWS effort. The Nature Conservancy also supports this proposal. In addition, Juneau county personnel and local conservation groups have voiced their support for a preservation project.

As suggested above, however, details of the protection plan are uncertain at this time. Issues remaining include:

- Funding for the project is uncertain, and prices per acre for easements or fee title may range as high as $500.

- Landowner participation is unclear. Landowners holding acreage in the area may not wish to form cooperative agreements, sell easements or sell their land.

- The timeline for plan implementation is unclear.

[27] This estimate is based on a FWS estimate of $500 per acre.

SUMMARY

Established in 1939, the NNWR is located in a largely agricultural area in an economic region comprised of Adams, Juneau, Monroe and Wood counties. The Refuge offers hunting, fishing, wildlife viewing and other recreational opportunities for nearby residents and area visitors. Timber harvesting and trapping also take place on the NNWR. In addition, the Refuge is home to a number of rare and endangered wildlife species.

Growth in local agriculture, and to a lesser extent increasing local population, pose hazards to the Refuge in the form of increasing fertilizer and pesticide runoff and strain on local water supplies. NNWR management seeks to develop a habitat restoration and preservation project encompassing land adjacent to the Yellow River to the east of the Refuge. By encouraging stewardship of the natural resources in this area, Refuge managers hope to reduce these threats.

The NNWR's role in the YRFA may take the form of cooperative agreements with local landowners, acquisition of easements to encourage certain land uses, fee title purchase of land within the area, or some combination of these activities. These options, particularly acquisition of easements and fee titles, have various effects on the local economy. These effects are the subject of study in Chapters 3 and 4 of this report.

CONTRIBUTION OF THE EXISTING NNWR TO THE REGIONAL ECONOMY — CHAPTER 3

The NNWR supports commercial, governmental and recreational activities that contribute to the vitality of the local economy. In this chapter, we consider the magnitude of this contribution. Specifically, we use regional economic modeling techniques, also known as input/output analysis, to characterize two categories of regional economic impacts:

- For refuge administration and management activities, road maintenance, trapping and timber harvesting taking place on the NNWR, we determine how the input demand and output flow associated with these activities affect other industries in the region.

- For key recreational activities such as wildlife viewing, fishing and hunting, we evaluate the linkages to supporting commercial industries such as sporting goods, restaurants and hotels.

We consider the impacts discussed above as they occur in three different years: 1996, 2011 and 2026. These approximately correspond to the present (or baseline condition), 15 years in the future and 30 years in the future. This analysis enables a consideration of changes in the regional economic contribution of the NNWR over time.

The chapter begins with a discussion of the concepts underlying regional economic modeling. We then discuss the methodology used to develop the regional models in this analysis, and present the results for the three time horizons considered. The modeling results characterize the magnitude of the economic relationship between the regional economy and commercial, governmental and recreational activities taking place on the NNWR.

NNWR IMPACT ON THE REGIONAL ECONOMY

The NNWR affects the economy through two media: the commercial and governmental activities occurring on the Refuge, such as Refuge spending and timber harvesting; and recreation expenditures by NNWR visitors. Three of the four commercial and governmental activities taking place on the Refuge (i.e., timber harvesting, trapping, and road maintenance) would likely occur on that land regardless of whether it is managed by the Refuge. Similarly, some local recreation spending would likely take place regardless of the existence of the Refuge. In particular, the number of outdoor recreation sites available in the area suggests that local residents would take advantage of nearby recreational opportunities in the absence of the Refuge. On the other hand, Refuge spending by the U.S. Fish and Wildlife Service (FWS) represents a wholly new injection of funds into the local economy that would not occur otherwise. For this reason, only spending by the Refuge can be considered a true stimulus to the local economy.

In addition, the estimates presented in this chapter reflect changes in the output of the local economy, but not a change in overall national output. Increases in output in the local economy reflect a redistribution of spending from another part of the nation, not a net increase in output for the nation as a whole. Similarly, decreases in the output of the study area imply that business has moved elsewhere within the U.S. to some other local economy. The appropriate measure of net gains and losses in overall national economic activity is consumer surplus, discussed in Chapter 5.

The estimates discussed below, therefore, should be considered in the context of these issues. Although the gains and losses associated with these changes in output are meaningful to the local economy, they are not relevant for the nation as a whole.

METHODOLOGY

Overview of Regional Economic Modeling

The concept of regional economic modeling seeks to characterize the interdependence of industries in a geographic region. Industries both purchase output from and supply input to other industries in a given region. As a result, the contribution of a particular industry to the regional economy is larger than the industry's output. For example, the timber industry sells its output to furniture producers and other processing industries, and, simultaneously, purchases trucks, saws, and other inputs from other regional industries. The presence of these linkages implies that employment and output in furniture and truck production are dependent upon the existence of the timber enterprises. An increase in timber output would spur increases in the output and employment of these secondary industries. Alternatively, if output in the timber industry were to decrease, the decline in total regional employment and output would likely be larger than the

total employment and output losses in the timber production sector. The goal of input/output modeling is to capture the extent to which industries are dependent on each other in this manner, and how they interconnect to form the regional economy.

The development of a regional economic model involves substantial sorting and organizing of economic data to characterize accurately the workings of the regional economy. First, to reduce the number of factors in the analysis, industries that affect the economy in a similar manner are grouped into sectors. Creation of an *input/output matrix* enables tracking of flows of goods and services between sectors. This matrix describes how much of each sector's input needs are met by the outputs of all other sectors in the area.[1]

A regional economic model uses the input/output matrix to generate a set of values known as multipliers, which further characterize the economic links between a particular industry and the regional economy. The multiplier quantifies the relationship between demand for a given industry's output and the output required of the regional economy. For example, an output multiplier of 1.26 associated with the timber harvesting industry implies that demand for $1.00 of timber requires $1.26 of output to be produced by the regional economy (i.e., the timber industry and all other regional industries). As this example suggests, industries with larger multipliers have a greater effect on the regional economy. In addition to output multipliers, most input/output models generate employment, value added and income multipliers which share the same basic principles.

Overview of the IMPLAN Model

Our regional economic models are developed using MicroIMPLAN (IMpact Analysis for PLANning), designed by the U.S. Forest Service.[2] This particular model is used by many state and federal planning agencies to evaluate the economic impact of policy choices. The IMPLAN input/output matrix incorporates data from a number of federal and state entities, including the Bureau of Economic Analysis and the Bureau of Labor Statistics. To group the industries for purposes of developing the input-output matrix and multipliers, IMPLAN uses the categories developed in the U.S. Office of Management and Budget's Standard Industrial Classification (SIC) code. We analyze the most recent data available, which are from fiscal year 1994.

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[1] It is important to emphasize that market prices, not consumer surplus, provide the basis for input/output analysis. The estimates provided are based on the dollar values of flows of actual goods and services, which do not reflect consumers' total willingness to pay for these items. In this sense, input/output analysis differs significantly from the recreational consumer surplus analysis provided in Chapter 5.

[2] The IMPLAN model is owned and maintained by the Minnesota IMPLAN Group, Inc. (MIG).

The results of IMPLAN's input-output analyses are presented as estimates of several important economic indicators, including final demand, total industry output, employee compensation income, property income, value added and employment. Each of these indicators is estimated for each industry group. The models and an overview of key results are discussed below.

Developing the NNWR Regional Economic Model

Because a large proportion of the commercial, governmental and recreational activity of interest occurs in Adams, Juneau, Monroe and Wood counties, our models are based upon data from these counties. Our focus on these four counties is important in interpreting the model results. Because the models incorporate data from these counties only, the estimates of the regional economic contribution of NNWR-related activities pertain solely to the joint economy of the four counties. The models do not indicate the contribution of NNWR-related activities to the economies of other counties or states, nor do they address impacts on the economies of foreign nations.

Exhibit 3-1

COMBINED BASELINE DATA FOR ALL INDUSTRIES IN ADAMS, JUNEAU, MONROE AND WOOD COUNTIES (1996 $)

Variable	Baseline Estimate	Description of Estimate
Total Industry Output	$7,669,000,000	Total output of all regional industries.
Employment	94,576	Total employment of all regional industries.

Source: IMPLAN Data Files for Adams, Juneau, Monroe and Wood counties.

The total output and employment for all industries in the four counties in 1994 are presented in Exhibit 3-1. As noted above, we use these baseline data to develop two sets of models: one that estimates the economic contribution of NNWR commercial and governmental activity and one that estimates the economic contribution of recreational activities that take place at NNWR. To estimate the regional economic effects of a particular policy scenario using IMPLAN, we enter into the model the estimated change in output in each industry under consideration. The model then calculates the change in the demand for inputs to that industry, which causes a change in supplying industries' output, a change in demand for the inputs to those secondary industries, and so on. As the initial change ripples through the economy, the model tracks changes in the demand, output, employment and other economic parameters associated with the industries in the region. These effects can be classified as *direct*, *indirect* or *induced*, depending on the source of the change:

- *Direct effects* are the changes in production in industries producing items for which demand has changed, or which have suffered a supply shock. These are the changes specified initially by the modeler.

- *Indirect effects* are changes in production in industries linked with the directly affected industries. For example, a decrease in demand for the output of one of the directly affected industries will lead that industry to decrease demand for inputs, thereby affecting industries that supply those inputs.

- *Induced effects* are changes in household consumption resulting from changes in employment brought about by the direct and indirect effects. For example, reductions in household consumption of medical and legal services may occur as a result of decreased regional employment.

The model then sums these effects across all industries, estimating the change in regional output, employment and other indicators that would result from the initial change in output.

It is important to recognize that the IMPLAN model estimates only the effects stemming directly from the policy change and not complementary effects that occur over time within the economy. For example, a reduction in the output of the timber harvesting industry would likely prompt local furniture producers to seek alternate supplies of lumber, thereby mitigating output and employment losses in that sector. Similarly, the IMPLAN model would not take into account the re-employment in other industries of persons who lose their jobs as a direct result of a decline in a particular industry. As a result, the net output or employment change associated with a policy change may be smaller than the effect estimated by the model. For purposes of our analysis, this caveat implies that the long-run net employment and output that these industries contribute to the regional economy may be smaller than the model predicts.

In addition, as noted above, the latest year for which we have input/output data is 1994. The analysis uses the 1994 regional economic data as a proxy for the regional economy in 1996, 2011 and 2026. Although using 1994 data as a proxy for the 1996 regional economy may be reasonably accurate, the 1994 data likely would not reflect the regional economy in 2011 and 2026 with significant accuracy. Thus, regional economic impact estimates for 2011 and 2026 should be interpreted with the understanding that the underlying input/output matrices may be somewhat inconsistent with anticipated economic characteristics in 2011 and 2026.

ESTIMATING THE IMPACT OF COMMERCIAL AND GOVERNMENTAL ACTIVITIES IN THE NNWR

We first estimate the contribution of commercial and governmental activities taking place on the NNWR to the regional economy, comprised of Adams, Juneau, Monroe and Wood counties, for the three years under study. We examine the regional economic impact of four activities: Refuge spending, trapping, timber harvesting and maintenance of NNWR roads by local towns. As noted above, to interpret these analyses, it is important to recognize that Refuge spending represents an infusion of funds into the local economy, whereas trapping, timber harvesting and maintenance of roads may take place in some form on land occupied by the Refuge whether or not the Refuge exists.

To apply the IMPLAN model, we posit the elimination of the four activities in the four-county region. Although this hypothetical construct is unrealistic, it is an effective modeling technique that enables us to isolate the proportion of the region's output and employment derived from the commercial and governmental enterprises taking place on the NNWR. Because the model is linear, the decrease in economic activity associated with the elimination of an industry is the exact inverse of the contribution of that industry to the regional economy. Therefore, the results obtained from this analysis illustrate the industry's role in the regional economy.

Exhibit 3-2 presents baseline output estimates for NNWR-related commercial industries and government enterprises for the years 1996, 2011 and 2026. The exhibit reports the same output in the years 1996, 2011 and 2026 for each of the activities because output in these activities likely will remain static over the time period of the analysis. The amount of timber and pelts harvested, the size of the NNWR budget, and spending on road maintenance are expected to remain stable over time. Therefore, the results of the relative impact of these activities on the regional economy is also expected to remain static. As shown, actual expenditures by the federal government on NNWR administration constitute the largest proportion of NNWR-related output. Road maintenance and timber harvesting follow, and trapping output is the smallest of the four.

Exhibit 3-2 also shows the results of the IMPLAN analysis, i.e., the estimated contribution of each industry to the regional economy. The second, third and fourth columns in Exhibit 3-2 present estimates of the total regional output, employment and employee compensation associated with each activity. These estimates reflect not only output and employment in the NNWR commercial or governmental activity under study but also output and employment in secondary industries that are dependent upon that activity.

The conclusions drawn from the NNWR-dependent commercial and governmental activity model are as follows:

- Refuge spending has the greatest effect on the regional economy, accounting for just under $1 million and approximately 16 jobs, and contributing $315,000 to employee salaries.

- NNWR timber harvesting and road maintenance contribute similarly to employment in the region, accounting for 1.3 and 1.7 jobs, respectively, and contributing approximately $30,000 each to regional salaries. However, timber harvesting accounts for approximately $190,000 of the regional economy, whereas road maintenance contributes only slightly more than half that amount ($100,000).

- Commercial trapping plays a minor role in the overall regional economy, accounting for only approximately $9,000 of regional output and less than one job.

Exhibit 3-2

REGIONAL ECONOMIC CONTRIBUTION OF NNWR COMMERCIAL AND GOVERNMENTAL ACTIVITIES IN 1996, 2011 AND 2026

Activity	Output (1996 $)	Contribution to Regional Output (1996 $)	Contribution to Regional Employment (persons)	Contribution to Employee Compensation (1996 $)
NNWR Refuge Spending	$624,200	$890,625	15.7	$313,453
Timber Harvesting	$153,758	$186,543	1.3	$33,817
Township Spending on NNWR Road Maintenance	$96,000	$102,072	1.7	$31,919
Trapping	$6,858	$9,334	<1	$1,371

Source: IEc IMPLAN analysis.

ESTIMATING THE IMPACT OF RECREATIONAL ACTIVITY IN THE NNWR

We have also developed an IMPLAN model to characterize the role of recreational activities that take place at the NNWR for each of the three years under study. The recreational activities examined in this model include recreational fishing, recreational hunting and wildlife viewing. The initial premise of this model is identical to that of the industry models, in that we assume the elimination of

recreational opportunities in order to isolate the contribution of these activities to the regional economy. However, recreation itself has little direct effect on the economy. Rather, the purchases of recreation-related goods and services are the medium through which recreation affects the regional economy. For example, people who decide to fish may purchase boats, rods and other equipment from sporting goods stores.

Because of this indirect link, modeling the contribution of recreational activities to the regional economy involves an additional step in which the modeler must estimate expenditures per recreation day on different recreation-related goods and services. The primary IMPLAN sectors affected by recreational activity are:

- hotels and lodging;
- grocery stores and restaurants;
- sporting goods stores; and
- transportation.

Once these per-day expenditures have been estimated, the annual volume of recreation expenditures can be calculated by multiplying the expenditures per day with our estimate of the annual number of NNWR visitor days for each activity. This annual estimate of visitor days reflects the extent of the link between recreation and economic activity.

To model the elimination of recreational opportunities in the NNWR, we assume that the number of recreation visitor days spent in the NNWR falls to zero from estimated activity levels in each of the three years under study. Thus, annual expenditures to support recreational activities would also be zero. To create this scenario within the model, we specify a reduction in visitor days equal to the recorded NNWR visitation in 1996 and estimated visitation for 2011 and 2026. We also supply the model with estimates of expenditures per visitor day. The model multiplies these factors together to estimate the reduction in output, final demand, employment and other indicators in affected regional businesses resulting from the reduction in the number of recreation days.

Three issues and caveats pertaining to the recreational activity model are noteworthy. First, the model includes the visitors to the Refuge who reside in the local area. In the absence of the Refuge, local residents may take advantage of similar recreational opportunities nearby (e.g., Sandhill Wildlife Area, Wood County Wildlife Area, and Meadow Valley Wildlife Area). As a result, the expenditures made by these visitors represent spending that likely would have taken place regardless of the existence of the Refuge, and thus do not constitute an infusion of funds into the local economy. In this case, the model may overestimate slightly the contribution of the Refuge to the local economy. However, the recreation areas nearby provide slightly different amenities than the Refuge. To the extent that residents would seek a recreational experience very

similar to that provided by the Refuge, they may travel outside the study area to find it. In this case, the model would correctly treat expenditures associated with the Refuge as an infusion of funds because, in the absence of the Refuge, residents would go elsewhere.

In addition, the model accounts for the fact that some purchases associated with NNWR recreation may occur outside the region. For example, many hunters live outside of the four-county region included in the model and may purchase items such as ammunition near their homes. By adjusting for extra-regional recreational purchases, the model avoids overestimating the regional economic effect of recreation.

Finally, the estimates of per-day expenditures we use to develop the regional economic analysis are not directly comparable to the estimates of consumer surplus we use to estimate the surplus value of NNWR recreation in Chapter 5. Whereas surplus value is a measure of a consumer's willingness to pay for an activity over and above current expenditures on that activity, the estimates used in these models reflect the actual expenditures made by recreators. We use these different estimates because the two analyses serve different purposes. Whereas the analysis of the surplus value reflects the net societal value of the recreational experience itself, the regional economic model estimates the contribution of recreation to the regional economy.

Exhibit 3-3 shows the inputs underlying the recreational activity model and the model's estimate of the total contribution to regional output and employment of NNWR recreational opportunities. The "Annual Number of Recreation Days" column shows the total number of recreation days per year for each activity. The visitor day estimate for 1996, reported in Chapter 2, is derived from RMIS data for that year. Based on historical trends in the number of state-wide hunting, fishing and viewing days derived from the *1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, we estimate that annual hunting days will decline by approximately one-third between 1996 and 2011, and by another third between 2012 and 2026. In addition, annual wildlife viewing days are estimated to increase by 18 percent between 1996 and 2011, and by another 18 percent between 2012 and 2026. Finally, fishing days are expected to remain constant throughout the time period under study.

We applied these estimates of annual visitor days to the average expenditures per day for each activity, shown in Exhibit 2-8. These estimates characterize the link between recreation participation and economic impact. Importantly, expenditures per day are not projected to increase in real terms during the three time periods studied, so these estimates were used for each of the models for 1996, 2011 and 2026. The final three columns of Exhibit 3-3 show the contribution of each recreational activity to total regional output, employment and employee compensation for each of the years examined. The model indicates the following:

Exhibit 3-3

REGIONAL ECONOMIC CONTRIBUTION OF NNWR RECREATIONAL OPPORTUNITIES IN 1996, 2011 AND 2026

Activity	Annual Number of Recreation Days	Contribution to Regional Output (1996 $)	Contribution to Regional Employment (persons)	Contribution to Employee Compensation (1996 $)
Year 1996 (Baseline)				
Fishing	7,325	$243,276	5.9	$65,338
Hunting	9,230	$249,237	7.2	$72,526
Wildlife Viewing	106,835	$2,054,201	55.3	$530,949
Year 2011				
Fishing	7,325	$243,276	5.9	$65,338
Hunting	6,350	$171,478	5.0	$49,900
Wildlife Viewing	125,933	$2,421,412	65.2	$625,862
Year 2026				
Fishing	7,325	$243,276	5.9	$65,338
Hunting	4,369	$117,657	3.4	$34,238
Wildlife Viewing	149,192	$2,868,631	77.2	$741,455

Source: IEc IMPLAN analysis.

- Wildlife viewing has the greatest effect on the combined economies of the four counties during all three time periods. This activity accounts for between $2.1 million and $2.9 million of regional output and between 55 and 77 jobs, contributing $531,000 and $741,000, respectively, to employee salaries. Although recreationalists engaged in nonconsumptive activities spend fewer dollars than do anglers and hunters, the significantly higher number of recreation days spent on wildlife viewing compared to hunting and fishing make it the greatest contributor to the regional economy of the three. In addition, the number of wildlife viewing days per year is projected to increase over time, unlike annual fishing and hunting days, thereby increasing the relative impact of this activity over time. As noted in Chapter 2, the estimate of the annual number of

recreation days is associated with significant uncertainty. As a result, the estimates of the regional economic impact of wildlife viewing on the NNWR should be interpreted with this uncertainty in mind.

- Currently, recreational hunting has the second greatest effect on the regional economy, accounting for $249,000 and 7.2 jobs, contributing $65,000 to employee salaries. This category also has the highest per-day expenditures of the three activities. However, annual hunting days are expected to decline over time, whereas fishing days are expected to remain constant. Therefore, during 2011 and 2026, hunting becomes the recreational activity contributing the smallest proportion of regional output, declining to a contribution of $118,000 and 3.4 jobs, contributing $32,000 to employee salaries. As noted in Chapter 2, the estimates of the annual number of hunting days are associated with a high degree of certainty; thus, the estimates of the regional economic impact of NNWR hunting are fairly accurate.

- Currently, fishing produces the third greatest regional economic effect, accounting for $243,000 of regional output and 5.9 jobs, contributing $65,000 employee salaries. Because annual fishing days are expected to remain constant, fishing surpasses hunting in economic contribution in 2011 and 2026 despite the fact that its regional economic contribution remains constant. Fishing is the second most expensive activity per day. As noted in Chapter 2, the estimate of the annual number of fishing days is somewhat imprecise; therefore, the estimates of the regional economic impact of NNWR fishing should be interpreted with this uncertainty in mind.

SUMMARY

This chapter provides an analysis of the regional economic contribution of key NNWR commercial, governmental and recreational activities. We conducted the analysis using IMPLAN, a widely-used regional economic impact model. Our methodology involved positing the hypothetical elimination of key commercial, governmental and recreational activities to isolate their influence on the regional economy. The IMPLAN models suggest that commercial and governmental activities associated with the NNWR, combined with recreational activity on the Refuge, make a valuable contribution to the regional economy by supporting secondary enterprises and jobs. Important results include the following:

- NNWR spending is the most important activity in the regional economy of the four activities studied, contributing approximately $900,000 in each of the years under study. The regional economic impacts of NNWR timber harvesting and road maintenance activities are approximately an order of magnitude smaller, contributing $190,000 and $100,000 to the economy, respectively. Trapping on the NNWR produces a very small regional economic effect, contributing approximately $7,000 to the regional economy.

- Expenditures by individuals participating in wildlife viewing at the NNWR play a role in the regional economy; projected increases in the number of visitor days to the NNWR for this activity imply that the contribution of this activity will increase significantly from 1996 to 2026. Similarly, individuals engaged in hunting and fishing also provide business to a number of local industries engaged in catering to recreational activities and tourism. The gradual decline in annual hunting days projected to occur from 1996 to 2026 implies that the contribution of this activity to the local economy also will decline.

CURRENT AND FUTURE ECONOMIC IMPACTS OF THE YELLOW RIVER FOCUS AREA — CHAPTER 4

In Chapter 3, we provide estimates of the economic impacts of commercial, governmental and recreational activities associated with the NNWR. In this chapter, we continue the regional economic analysis by estimating the economic effects that would be associated with a Yellow River Focus Area (YRFA) project. The analytical approach described in this chapter is similar to that used to generate the results presented in Chapter 3 in that we apply IMPLAN to estimate the regional economic impacts and model the regional economic contribution of the same categories of recreational activities considered earlier. We also continue to consider three time periods within our analysis: a baseline, or 1996, scenario as well as scenarios that represent conditions 15 years and 30 years in the future.

To model the economic impact that would result from expansion of the NNWR, we need to understand the time period over which acquisition would occur and the types of properties that would be purchased (i.e., the current or expected future use of these parcels). This information is not, however, available at this time. Thus, we choose instead to present estimates of the economic impact associated with a change in land use from private ownership to wildlife refuge for an "industry acre" and a "composite acre". The "composite acre" metric allows us to examine the economic impact of acquiring an acre of land for inclusion in the NNWR whose alternative land use represents a weighted average of all existing land uses in the relevant counties. This metric is provided to allow the U.S. Fish and Wildlife Service (FWS) an order-of-magnitude estimate of the impacts of an acquisition strategy given no knowledge of the specific parcels to be purchased. The "industry acre" metric allows us to consider the expected regional impact from the conversion of an acre of land in a specific land use (i.e., potato farming) to refuge. This metric allows the Service to place bounds on the potential effects of any specific acquisition strategy.

This chapter also estimates the foregone tax revenues to local governments that would result should the NNWR acquire land in the YRFA. Given uncertainty in the timing and nature of these purchases, we estimate the gross foregone tax revenues for each relevant land use as well

as for a composite of current land uses (i.e., an acre representing the weighted average land use). In addition, we calculate what the FWS annual Refuge Revenue Sharing payment would be, to estimate the *net* foregone tax revenues per acre.

Finally, we use the IMPLAN model to estimate the regional economic contribution of additional recreation on the YRFA. This analysis extrapolates the per-acre economic contribution of recreation on existing NNWR acres to new YRFA acres. We estimate the extent to which this contribution mitigates the economic impacts associated with expansion, and offer estimates of the amount of additional YRFA recreation required to offset completely these regional economic impacts.

REGIONAL ECONOMIC IMPACTS OF YRFA ACQUISITION

This section provides estimates of the regional economic impact associated with YRFA acquisition; that is, removing an acre from commercial use and turning it into Refuge land. This section first describes the current and projected industrial uses of the YRFA (assuming no NNWR acquisition), then provides estimates of the economic impact associated with an "industry acre" and a "composite acre".

Characterization of Current Land Use in the YRFA

Estimating the contribution of the YRFA to the regional economy in the baseline and 15- and 30-year scenarios requires (1) characterization of current land use and (2) projections of land use changes in 15 and 30 years (assuming no NNWR acquisition). This section describes current and future YRFA land use.

Land Use in the Baseline Scenario

Characterization of the baseline land use requires obtaining an inventory of the current uses of the property in the YRFA. Based on real property listings in Juneau and Wood counties, IEc developed a list of all properties in the YRFA, including any improvements to them, and their property values. The listings were categorized into several relevant headings (e.g., agriculture, timber production).[1]

IEc then developed estimates for the percentages of YRFA land devoted to cranberry and potato production. Although county records do indicate whether or not land currently supports agriculture, they do not provide detail on specific crops grown. Therefore, IEc estimates for acreage devoted to cranberry and potato crops reflect NNWR management estimates derived from aerial maps of the YRFA.

[1] Data compiled by Hawthorne Beyer, University of Wisconsin, October 1997.

Exhibit 4-1 provides a summary of the composition of the YRFA land use in the baseline year (1996) as well as land use projections for other years. As shown Exhibit 4-1, timber production accounts for a significant amount of acreage in the YRFA, followed by agriculture.

Exhibit 4-1

PERCENTAGE BREAKDOWN OF LAND USE IN YRFA FOR BASELINE, 15-YEAR AND 30-YEAR SCENARIOS

	1996 (Baseline)		2011 (15-Year)		2026 (30-Year)	
Activity	**Acres**	**Percent of Total Acres**	**Acres**	**Percent of Total Acres**	**Acres**	**Percent of Total Acres**
Cranberry	400	2.1%	433	2.3%	446	2.4%
Potato	70	<1.0%	85	<1.0%	100	<1.0%
Timber	11,445	61%	11,445	61%	11,445	61%
Agriculture and Dairy	2,350	13%	2,302	12%	2,274	12%
Residential	439	2.3%	439	2.3%	439	2.3%
Commercial	18	<1.0%	18	<1.0%	18	<1.0%
Public	2,268	12%	2,268	12%	2,268	12%
Other[1]	1,811	10%	1,811	10%	1,811	10%
Total Acres Available[2]	**18,801**		**18,801**		**18,801**	

[1] "Other" category includes swampland and tax exempt land.

[2] The total YRFA acreage estimate used in this analysis is greater than the official total YRFA acreage (18,100 acres; see Chapter 2). In apportioning YRFA acreage across various land uses, parcels partially encompassed by the YRFA boundary were counted in their entirety, resulting in an acreage estimate larger than the official YRFA estimate. To avoid losing precision by adjusting these estimates using a scaling factor, and because the analysis based on these estimates examines individual acres rather than the YRFA as a whole, we used the larger number in our analysis.

Source: IEc analysis.

Land Use in the 15- and 30-Year Scenarios

IEc also estimated the characteristics of YRFA land use in 2011 and 2026. The following information and assumptions underlie these projected land use scenarios:

- The amount of land devoted to cranberry production is expected to increase at a rate of approximately four percent annually between 1996 and 2011 and 1.5 percent annually between 2012 and 2026.[2]
- Expansion of cranberry and potato production is expected to occur on acreage formerly devoted to other (nonspecific) agricultural production.[3]
- The amount of land devoted to potato production has been nearly stable for a decade and is assumed to increase only slightly in the future.[4]
- Residential expansion over the 30-year time horizon will be limited as a result of poor ground water quality and a high water table.[5]
- Commercial (manufacturing) land use is not expected to increase significantly over the time horizon of this analysis.
- Existing public lands will not be sold for commercial development.[6]

Exhibit 4-1 presents the expected acreage devoted to various land uses in the YRFA in the 15- and 30-year scenarios, as well as the corresponding percentage of total YRFA land represented by each of those uses. Reflecting the assumptions listed above, acreage devoted to cranberry, potato and nonspecific agricultural production are estimated to change over the 15- and 30-year time periods. Conversely, the percentage of land devoted to other uses remains constant.

Industry Acre Analysis

To allow Refuge management and other interested officials to estimate the regional economic impacts of acquiring additional Refuge land, we developed the concept of an industry acre. The

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[2] Wisconsin Department of Agriculture, Trade, and Consumer Protection, *Wisconsin Agricultural Statistics, 1997;* personal communications with Refuge management and local assessors, September 1997.

[3] Personal communication with Larry Wargowsky, February 1998.

[4] Personal communications with Juneau and Wood County Agricultural Extension Officers, September 1997 and with Larry Wargowsky, February 1998.

[5] Personal communications with local assessors, September 1997.

[6] Personal communication with Juneau County Agricultural Extension Officer, September 1997. As of March 1, 1997, the majority of county lands within the YRFA have been officially listed as "county forest lands." With this designation, it is very unlikely that this land will ever be sold. Some county land listed as "community forest lands" may be sold, but this area accounts for only a minor portion of county owned land in this region.

contribution of an industry acre to regional output represents the total regional impact of the Refuge acquiring an acre of land that, prior to acquisition, was used for a specific purpose.

Development of Industry Acre Estimates

To estimate the regional economic contribution of YRFA industries, we developed an IMPLAN model for each of the commercial activities of interest: nonspecific agriculture production, cranberry production, potato production and timber harvesting. Similar to the model for the existing Refuge presented in Chapter 3, this model assumes a reduction in annual output equal to the output of the acreage (listed in Exhibit 4-1) currently devoted to each use in the YRFA. The model produces an estimate of the total economic contribution to the four-county study area of the existing acreage devoted to each use.

To estimate the economic contribution of each acre devoted to a particular activity, we then divide the total output contribution estimated in the IMPLAN analysis for each activity by the number of acres dedicated to that activity in the YRFA.

Results of Industry Acre Analysis

Exhibit 4-2 presents the contribution of each industry acre in the YRFA to the regional economy. The regional economic contribution of an acre in cranberry production is significantly higher than land in other uses. Potato farming produces the second largest effect on the regional economy, followed by nonspecific agriculture and finally timber production.

Composite Acre Analysis

Under some potential acquisition scenarios, the current use of land proposed for acquisition may be unknown. Therefore, estimates of the per-acre regional economic contribution of various land uses, such as those shown in Exhibit 4-2, may be of limited use. To provide a metric for estimating the regional economic impact of an acquisition scenario in the absence of complete information, we develop and estimate the regional economic contribution of a "composite acre". A composite acre reflects the weighted average of each industrial land use in the entire YRFA. Similarly, the regional economic impact associated with acquiring such a hypothetical composite acre reflects the proportional regional economic impact of each of the underlying land uses. Although not a perfect substitute for the "industry acre", described above, the composite acre contribution estimate provides a reasonable approximation of the regional economic impact of acquiring an acre of land in cases where land use information is unknown.

Exhibit 4-2

REGIONAL ECONOMIC IMPACT PER ACRE OF LAND IN VARIOUS USES UNDER BASELINE, 15- AND 30-YEAR SCENARIOS (1996$)

	1996 (Baseline)				2011 (15-Year)				2026 (30-Year)			
Land Use	**Output**	**Total Impact**	**Acre-age**	**Per-Acre Impact**	**Output**	**Total Impact**	**Acre-age**	**Per-Acre Impact**	**Output**	**Total Impact**	**Acre-age**	**Per-Acre Impact**
Cranberry Production	$3,904,000	$5,506,854	400	$13,767	$4,226,080	$5,961,169	433	$13,767	$4,352,960	$6,140,142	446	$13,767
Potato Production	$124,215	$167,768	70	$2,397	$150,833	$203,719	85	$2,397	$177,450	$239,669	100	$2,397
Agricul-ture and Dairy	$846,000	$1,356,046	2,350	$577	$828,720	$1,328,349	2,302	$577	$818,640	$1,312,192	2,274	$577
Timber Harvesting	$132,648	$170,438	11,445	$15	$132,648	$170,438	11,455	$15	$132,648	$170,438	11,445	$15

Source: IEc IMPLAN analysis.

To develop the composite acre analysis, we begin with the per-acre industry estimates presented in Exhibit 4-2. We multiply these per-acre estimates by the fraction of YRFA land devoted to that use, and sum these fractional contributions to yield the regional economic contribution of a hypothetical composite acre.

Exhibit 4-3 presents our estimates of the regional economic contribution of a composite acre for the baseline (1996), 15-year and 30-year scenarios. The composite acre, as noted above, reflects a mixture of land uses, including cranberry farms, potato farms, timber tracts and miscellaneous agricultural production. The regional economic contribution of the composite acre increases over time primarily because the proportion of land in the YRFA devoted to cranberry and potato production is expected to rise. Cranberry production and potato production provide the largest and second largest contributions per acre to the regional economy, and therefore as their proportion of the composite acre grows, the economic contribution of the composite grows as well. In addition, the proportion of acreage devoted to nonspecific agricultural production, which contributes less per acre to the regional economy than cranberry or potato production, falls. The proportions of the other land uses in the composite acre, as well as their contributions per acre, remain constant over the time period of the analysis.

Exhibit 4-3

REGIONAL ECONOMIC CONTRIBUTION OF COMPOSITE ACRE IN YRFA AND EXISTING NNWR ACRE FOR BASELINE, 15-YEAR AND 30-YEAR SCENARIOS (1996$)

Scenario	YRFA Composite Acre Contribution	Existing NNWR Acre Contribution
Baseline (1996)	$383.30	$85.56
15-Year (2011)	$408.50	$92.19
30-Year (2026)	$417.87	$101.21

Source: IEc IMPLAN analysis.

In Exhibit 4-3, we also present the per-acre regional economic contribution of existing NNWR acres, to provide context to composite acre contributions. The estimates for the per-acre regional economic contribution of the existing NNWR consist of the total, from Chapter 3, of the annual contribution of commercial, governmental and recreational activities taking place on the existing Refuge divided by the total current Refuge acreage (43,655 acres). On a per-acre basis, the contribution of the existing Refuge is not as great as the contribution of the current use of the YRFA lands.

TAX IMPACTS OF YRFA ACQUISITION

In addition to the potential commercial revenues that may be lost under the YRFA acquisition scenario, communities in which these lands are located would also forego tax receipts. Below we estimate the tax receipts per acre of land that would be foregone should the NNWR acquire land in the YRFA. These revenues are estimated for each land use type ("industry acre") and for a representative ("composite acre"). Because land usage does not change significantly over the 30-year period of analysis, we estimate tax impacts for the baseline (1996) only.

Tax Revenue Per Industry Acre

Our analysis with tax impacts begins with an estimate of the tax revenue currently collected on a parcel dedicated to a particular industry use. To estimate tax revenue, we performed the following calculations:

- To estimate total land value, we tabulated property listings for all lands within the YRFA boundaries in both Juneau and Wood counties, including any improvements.[7]
- We estimated the appraised value of lands using a weighted average assessment ratio of 88 percent of market value, based on ratios of the towns surrounding the YRFA in Juneau and Wood counties.
- We developed a weighted tax of $22.76 per $1,000 of appraised property value based on the weighted average tax rates of the towns surrounding the YRFA in Juneau and Wood counties.[8]

We then estimated the tax per activity acre (e.g., tax per acre of land in cranberry production) by multiplying the total appraised property value by the weighted tax, then dividing by the respective number of industry acres. Exhibit 4-4 shows the estimated tax per acre of YRFA land in various uses. As would be expected, residential acreage has the highest per-acre tax, followed by cranberry farm acreage.

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[7] Data compiled by Hawthorne Beyer, University of Wisconsin, October 1997.

[8] These towns are: Armenia, Finley, Kingston and Necedah in Juneau County; and Remington and Dexterville in Wood County. Because about 75 percent of the YRFA is in Juneau County, the weights were 75 percent for Juneau County and 25 percent for Wood County.

Exhibit 4-4

FOREGONE TAX PER INDUSTRY AND COMPOSITE ACRES (1996$)

Acre Use	Tax Per Acre	FWS Refuge Revenue Sharing Payment		Net Forgone Tax Per Acre	
		66% of RRS Payment	94% of RRS Payment	66% of RRS Payment	94% of RRS Payment
Agricultural	$6.49	$1.41	$2.01	$5.08	$4.48
Cranberry	$158.44	$34.46	$49.08	$123.98	$109.36
Potato	$9.18	$2.00	$2.84	$7.18	$6.34
Timber	$6.47	$1.41	$2.00	$5.06	$4.47
Timber MFL [1]	$6.21	$1.35	$1.92	$4.86	$4.29
Commercial	$20.46	$4.45	$6.34	$16.01	$14.12
Residential	$199.19	$43.32	$61.70	$155.87	$137.49
Swamp and Waste	$3.11	$0.68	$0.96	$2.43	$2.15
COMPOSITE	$8.12	$1.76	$2.51	$6.36	$5.61

[1] Managed Forest Law Land
Source: IEc analysis.

Refuge Revenue Sharing Payments Per Industry Acre

In the event that the Refuge assumes control of YRFA acreage, taxes would not longer be assessed to those lands. However, the Refuge Revenue Sharing Act of 1935, as amended, provides that FWS, on behalf of the Refuge, make annual Refuge Revenue Sharing (RRS) payments to counties or the lowest unit of government that collects and distributes property taxes. In the state of Wisconsin, each town is responsible for collecting property taxes. Payments to towns are based on the whichever of the following calculations results in the largest amount:

- $0.75 per Refuge acre;
- 25 percent of the net receipts collected from Refuge lands in the county; or
- Three-quarters of one percent of the appraised property value of the Refuge.

In the State of Wisconsin, three-quarters of one percent of the NNWR appraised property value yields the greatest RRS payment. Thus, we estimate the annual RRS payment for each YRFA industry acre by multiplying the appraised property value by three-quarters of one percent.

However, historically FWS has paid only a fraction of its annual RRS payment, generally between 66 and 94 percent of the estimated total. Therefore, to calculate the effective RRS payment, we multiply the estimated payment by 66 and 94 percent, respectively, to estimate a

range for the effective annual payment. Columns three and four of Exhibit 4-4 show this range for YRFA land in various uses. Like tax assessments, RRS payments are greatest on land used for residential homes and cranberry crops.

Foregone Tax Revenue Per Industry Acre

We estimated the net foregone tax per activity acre as total tax per activity acre less the estimated effective range of RRS payments. This foregone tax represents the funds that would not be collected for each acre of land the NNWR acquires in the YRFA currently in that particular land use.

Exhibit 4-4 presents the foregone tax revenue for each of the current land use designations. The second column shows the tax per acre of industry land and the third and fourth columns show the effective FWS RRS payments for that acre at 66 and 94 percent of the estimated payment. The final two columns show the difference between the tax per acre and the range of effective RRS payments, which is the foregone tax revenue per industry acre. Foregone taxes range from a low of $2.15 for wetlands to $155.87 for residential land.

Foregone Tax Revenue for a Composite Acre

Similar to the analysis for the regional economic impact of a composite acre provided earlier in the chapter, we also develop an estimate of the foregone tax associated with a composite acre. This acre reflects the proportions of land in the YRFA currently dedicated to various industrial activities. Therefore, the tax per composite acre represents the weighted average of the taxes for various activity acres in the YRFA. We calculate the composite acre tax by estimating the proportional tax contribution of each industry acre to the composite, then summing them. As an example, agricultural land comprises 2,350 acres of the YRFA, or about 13 percent of the total. The annual property tax for an acre of agricultural land is $6.49. Because agricultural land is 13 percent of the total YRFA, 13 percent of its tax is included in the composite acre tax.

We then estimated the FWS contribution for a composite acre. First, we multiply the total property value of the YRFA by the FWS percentage RRS payment of three-quarters of one percent of the property value. Then, we multiply the estimate by 64 to 94 percent to calculate the effective annual RRS payment range.

The last row in Exhibit 4-4 presents the foregone tax revenue for a composite acre.

RECREATION AND REFUGE ACTIVITY IMPACTS OF YRFA ACQUISITION

Expansion of the NNWR will provide additional recreational opportunities for visitors and residents, possibly causing an increase in recreational activity on the Refuge. The regional economic impact of removing YRFA acreage from agricultural or other private sector use and incorporating it into

the Refuge will be mitigated somewhat by the fact that increased recreation will spur regional economic activity.

In Chapter 3, we develop estimates of the regional economic contribution of NNWR recreation. To extrapolate these estimates to potential recreation on the YRFA, we transform these estimates to reflect the regional economic contribution per recreational acre of each activity. Because the hunting and fishing seasons are expected to be the same on the YRFA and the existing refuge, we do not make adjustments for length of season. We then divide the total economic contribution of recreation by acreage to arrive at the per-acre recreation contribution for each type of recreation. Exhibit 4-5 presents these estimates for each major recreational activity and for the total of the three activities.

Exhibit 4-5

REGIONAL ECONOMIC CONTRIBUTION OF RECREATION PER ACRE OF YRFA LAND FOR BASELINE, 15-YEAR AND 30-YEAR SCENARIOS (1996$)

Activity	1996 (Baseline)	2011 (15-Year)	2026 (30-Year)
Fishing	$16.72	$16.72	$16.72
Hunting	$17.13	$11.78	$8.09
Wildlife Viewing	$47.06	$55.47	$65.71
TOTAL	$80.91	$83.97	$90.52

Source: IEc analysis.

These estimates are significantly smaller than the per-acre regional economic impact shown in column two of Exhibit 4-3. Exhibit 4-6 presents the net regional economic impact per acre, which reflects the difference between the regional economic impact and the mitigating contribution of projected increased recreation on the YRFA.

One way to mitigate the net economic impact of the acquisition scenario would be to increase the level of recreational activity per acre, to increase the economic activity associated with purchases made for recreation in the region. To estimate the number of additional recreation days needed, we assume that the economic contribution of a recreation day would be the same for the YRFA as for the existing Refuge. We then calculate the number of additional days per acre required to stimulate enough economic activity to offset the net economic impact per acre. Exhibit 4-6 presents the estimates of days needed per activity type. As would be expected, the number of days required to offset the economic impact per acre increases over time as the economic contribution of a YRFA acre used for industrial purposes increases. For comparison purposes, current recreational use on the existing Refuge is 0.5 days of fishing per acre, 0.6 days of hunting per acre, and 2.4 days of recreation per acre. Therefore, the increase in recreation days required to mitigate completely the economic impact of acquisition is substantial.

Exhibit 4-6

NET ECONOMIC IMPACT OF YRFA

Scenario	Economic Impact Per Acre[1]	Economic Contribution of New Recreational Activity Per Acre	Net Economic Impact Per Acre	Additional Recreation Days Per Acre Needed to Offset Impact[2]	
1996 (Baseline)	$383.30	$80.91	($302.39)	Fishing	9.1
				Hunting	11.5
				Viewing	15.7
2011 (15-Year)	$408.50	$83.97	($324.53)	Fishing	9.8
				Hunting	12.0
				Viewing	16.9
2026 (30-Year)	$417.87	$90.52	($327.35)	Fishing	9.9
				Hunting	12.2
				Viewing	17.0

[1] The estimates reported are for the composite acre.
[2] The estimates of days are mutually exclusive. For example, in the baseline scenario, *either* 9.1 fishing days, *or* 11.5 hunting days, *or* 15.7 viewing days would be required to offset the net economic impact.
Source: IEc analysis.

SUMMARY

This chapter estimated the regional economic impacts, the local tax impacts, and the economic contribution of additional recreational activity that would result from NNWR land acquisition in the YRFA. We present regional economic impacts on a per-acre basis, using two types of metrics. Specifically, we use IMPLAN to estimate the regional economic impact of each "industry acre", or acre currently in agricultural use, as well as a "composite acre" which reflects the proportions of land currently in various uses in the region. These per-acre estimates reflect the regional economic impact of the Refuge acquiring an acre of land currently used for a specific industry or an acre in nonspecific use. Our analysis showed:

- The regional economic contribution of an industry acre ranges from a low of $15 for the timber industry to a high of $13,767 for the cranberry production industry.

- The regional economic contribution of a composite acre ranges from $383.30 in the base year scenario to $417.87 in the 30-year scenario.

The tax impact analysis is based on the fact that current taxes paid on YRFA land are greater than the RRS payment that the FWS would pay if YRFA land were acquired. Similar to the regional economic impact analysis, we calculated the net foregone tax revenue on a per-acre basis for both an industry acre and a composite acre. The analysis calculates the total tax paid on YRFA lands, subtracts the RRS payment (expressed as a range to reflect uncertainty in the effective payment rate), and arrives at a net foregone tax. Net foregone taxes for specific industry acres range from a low of

$2.15 for wetlands assuming an effective RRS payment of 94 percent to $155.87 for residential land assuming an effective RRS payment of 66 percent, while the net foregone tax revenue for a composite acre ranges from $8.95 to $10.14 assuming a range of 94 to 66 percent, respectively.

Finally, the analysis examines the regional economic contribution of additional recreation on the YRFA. The analysis estimates the net economic impact of acquiring an acre of YRFA land, and presents a summary of the number of additional recreation days per acre necessary to stimulate enough regional economic activity to offset the impact. The net economic impact per acre ranges from approximately $302.39 in 1996 to $327.35 in 2026. The number of additional recreation days required to mitigate this impact ranges from a low of 9.1 fishing days in 1996 to a high of 17.0 wildlife viewing days in 2026.

WELFARE BENEFITS OF THE REFUGE AND THE YRFA CHAPTER 5

In Chapters 3 and 4 we present analyses of the contribution recreational expenditures associated with the NNWR make to the economies of the four counties neighboring the Refuge. These economic contribution measures represent the economic impact that direct dollar expenditures on recreation have on the local economy – often referred to as "multiplier" effects. In this chapter we focus our analysis on estimating the economic value associated with the NNWR using a welfare-theoretic framework. Economic welfare values represent the benefits, or economic "surpluses", consumers derive from these activities, over and above the cost of participating. In this chapter we provide order-of-magnitude estimates of the welfare value associated with the NNWR in its current state, as well as an estimate of the additional benefits that would result under a Refuge expansion scenario. Specifically, we provide:

- Discussion of the concept of economic welfare value and the methods used by resource economists to estimate welfare value;
- Estimates of the welfare values associated with various activities that take place at the Refuge, based on the existing literature;
- Estimates of the total economic welfare value produced by the Refuge, by recreational activity;
- Estimates of the per-acre welfare values generated by recreational activities taking place at the NNWR;
- Estimates of the social welfare benefits that would result from the NNWR acquiring an acre of land for recreational opportunities in the YRFA; and
- Discussion of the ecological and passive use benefits associated with the NNWR, both in its current state and for those lands proposed for acquisition.

This chapter is comprised of five sections. The first section discusses the methodology and key concepts behind economic welfare value. The second section provides our analysis of the economic welfare value of the major recreational activities that take place on the NNWR. The third section

presents our analysis of the additional economic benefit that would accrue to individuals from an expansion of the NNWR. The fourth section provides an assessment of the economic value of the ecological services provided by the Refuge. Finally, the last section summarizes our results of the economic welfare analysis.

METHODOLOGY AND KEY CONCEPTS

Economists define the economic, or "social welfare", benefits provided by a natural resource as the sum of individuals' willingness to pay for the services the resource provides, net of any costs associated with enjoying those services. For example, an individual may pay nothing to swim in a lake. This individual, however, derives enjoyment from swimming and therefore has an implicit willingness to pay for that experience. Similarly, a hunter will purchase ammunition, a license and other supplies needed for a day of hunting. Beyond these market expenditures, however, the hunter likely has a residual value for the experience of a day of hunting. In both cases, the measure of willingness to pay, net of actual expenditures, is referred to as *consumer surplus*.

Consumer surplus is unique to the recreational experience being measured. For example, when a tract of land is closed to hunting, hunters lose the consumer surplus associated with a hunting day on that land. However, assuming the hunter finds another place to hunt, expenditures on ammunition and other supplies will still occur. As a result, total expenditures on hunting remain the same, even though one community will lose the hunter's business and another will gain. This example presents a key difference between analyses of consumer surplus and analyses of recreational expenditures: the loss of a local recreation opportunity implies only a change in the location of recreational expenditures, whereas the loss of that opportunity *eradicates* that day's consumer surplus. Therefore, reductions in local recreation days not only imply that the local economy forgoes recreation-related purchases, but also that the national economy loses income, expressed as consumer surplus.

Because many natural resource services, including recreational services, are not traded in the marketplace, willingness to pay cannot be directly measured by studying market transactions. Instead, economists have developed a variety of analytic techniques to measure consumer surplus. These methods, which are grounded in the theory of consumer choice, utility maximization, and welfare economics, attempt to uncover individuals' willingness to pay for natural resource services directly, through survey research methods, or indirectly through the examination of behavior in related markets. For example:

- The *Contingent Valuation* (CV) method involves direct elicitation of willingness to pay from individuals through the use of carefully designed and administered surveys. For example, an individual might be asked to state her maximum willingness to pay to access a fishing site, over and above those costs she currently incurs in visiting the site. Alternatively, a respondent may be asked to state her willingness to pay to preserve a parcel of land to enhance wildlife populations.

- *Revealed Preference* approaches are premised on the assumption that the value of natural resource services to users can be inferred from indirect economic measures. A commonly used revealed preference technique is the travel cost approach. For example, willingness to pay for camping opportunities can be estimated by observing how the number of visits individuals make to a campground varies with the cost of traveling to the campground. By studying the demand for a site at various distances from the site, economists are able to generate a "demand curve" for the site. Such a demand curve represents the change in demand that occurs as price increases, where price is reflected in increasing travel costs incurred by potential users. Similarly, property values can be influenced by proximity to an environmental amenity or disamenity; econometric analysis based on hedonic pricing theory can estimate the nature and magnitude of such effects, providing a basis for valuing natural resource services.

The methods discussed above, as well as others applied by economists, could be applied to estimate the economic welfare value of the NNWR. Successful implementation of these primary research techniques, however, would require resources beyond the scope of this study. Instead, we apply a "benefits transfer" approach, using a technique known as the activity day/trip method.[1] Benefits transfer involves the application of benefits estimates, functions, data and/or models developed in one context to address a similar resource valuation question in an alternative context. Benefits transfer in its simplest form involves multiplying existing estimates of consumer surplus per activity day, as obtained from the revealed preference or contingent valuation literature, by estimates of the total number of days that people engage in a given recreational activity. Thus, by applying unit-day values to an estimate of total annual activity, it is possible to estimate consumer surplus values for particular recreational pursuits such as wildlife viewing or hunting. A similar benefits transfer based approach is used to estimate the non-use value of the NNWR, including its value as a preserve for wildlife and other species.

RECREATIONAL VALUES FOR THE NNWR

The NNWR currently provides individuals with a variety of recreational activity opportunities, including hunting, fishing and wildlife viewing. Using a benefits transfer approach, we estimate the surplus value participants hold for each of these activities. To do this, we rely on literature estimates of welfare values for a day of participation for a given recreational activity and apply them to estimates of the number of participation days per year at the NNWR. As discussed in Chapter 2, we obtain our estimates of the number of participation days for each recreational activity in the NNWR from the 1996 Refuge Management Information System (RMIS) for the NNWR. In this section we discuss the main

[1] In the case of the NNWR, we assume that most of the trips taken to the site are day trips. Thus, one trip is assumed to equal one day.

sources for our activity day value estimates, and present our estimates of value associated with each of the recreational activities.

Activity Day Values

As mentioned above, we use a benefits transfer approach to estimate values for current recreational activities on the NNWR. Although this technique has been used for many years to evaluate environmental benefits and to assess natural resource damages, it continues to generate some controversy in the environmental and natural resource economics community. This controversy focuses on the applicability of welfare value estimates developed for a particular site in one context to the same or similar site in another context. Determining whether an existing study is appropriate for benefits transfer requires consideration of: (1) the quality of the existing study and (2) the similarity between the original and current sites, both in terms of location and the circumstances of the study (e.g., the pollutant being analyzed in each case). For the NNWR, we have taken these factors into consideration in conducting benefits transfer to estimate welfare values. We identified several high-quality studies from which to transfer welfare values for each of the key recreational activities. Although we summarize in the sections that follow the literature we use to conduct the benefits transfer for each of the recreational activities, we briefly summarize the most important sources of welfare value estimates below.

- **U.S. Fish and Wildlife Service Studies of Net Economic Welfare Values:** In 1985 and 1991 the FWS reported net economic welfare values for fishing, hunting and wildlife viewing across the U.S.[2] These reports provide per-day and per-trip welfare value estimates for recreational fishing, hunting and primary non-consumptive wildlife activities (e.g., viewing, photographing) by state.

- **Bergstrom and Cordell (1991):** Bergstrom and Cordell conducted an analysis of the value of outdoor recreational activities in the U.S. The authors sample U.S. counties and apply a multi-community, multi-site travel cost model to estimate demand equations for 37 outdoor recreational activities and trip welfare values, including hunting, fishing and wildlife viewing values.

- **Walsh, Johnson and McKean (1992):** In 1992, Walsh, Johnson and McKean published a summary of net economic welfare values per recreation day for a variety of different types of recreation. Their summary includes information from 120 outdoor recreation demand studies, and provides mean and median welfare value estimates for 19 different categories of benefits. The summarized studies use a variety of methodologies, including travel cost and contingent valuation models. Because some researchers used mail surveys and other techniques that do

[2] U.S. FWS, 1985, 1991.

not fully conform with the standards set by the 1992 NOAA Panel on contingent valuation, there is reason to believe that some of the welfare value estimates reported in the summarized studies may be high.[3]

- **U.S. Fish and Wildlife Service Sport Fishing Valuation Database:** The FWS recently developed a database of 111 studies that provide estimates of the economic welfare value for sport fishing resources across the U.S.[4] This database of sport fishing welfare valuation studies provides a detailed account of the contents of travel cost and contingent valuation studies conducted between 1975 and 1996. In addition to welfare estimate information, this database describes, to the extent possible, the nature of the resource and the resource change that provides the basis for these welfare estimates. In addition, for each of the reported estimates, the database records study information describing the valued resource (including species and resource quality characteristics), resource ecosystem (including location and water type), survey (including respondent sample information) and valuation methodology.

Each of these 111 studies provides estimates of recreational fishing values. The database excludes studies from the database that provide welfare values for several recreational activities simultaneously (e.g., studies that provide total recreational values including, for example, swimming, boating and fishing values). The majority of the studies are from peer reviewed journals; several are government reports, working papers and technical reports.

[3] In 1992, NOAA commissioned a panel of economists and other experts to review the CV method and its application for measurement of passive use values. Drawing on presentations at a public hearing, written statements submitted by interested parties, and examination of the existing CV literature, the panel concluded that CV studies convey useful information about the valuation of natural resources, provided that a number of conditions are met in the design, implementation and interpretation of the CV survey. One fundamental issue addressed by the panel was the concern that a hypothetical market, when posed to survey respondents, yields results that are biased upward in comparison to the results of actual market transactions. The panel concluded that calibration of these results to adjust for the upward bias associated with the framing and/or order of questions is currently not possible. Therefore, as a general guideline, the panel urged practitioners of CV surveys to "lean in the conservative direction [in making key survey design decisions], as a partial or total offset to the likely tendency to exaggerate [willingness to pay]" (National Oceanic and Atmospheric Administration, 1993).

[4] Markowski et al., 1997

The studies in the database cover a wide range of species, fisheries and values across the U.S. The prevalent target species valued include salmon, trout, pike, bass, walleye and mackerel. Respondent fishing modes include shore fishing, private and charter boat fishing, and to a lesser extent, fly fishing.

Hunting

The NNWR offers several types of hunting opportunities, including hunting for big game species (e.g., deer), migratory birds, waterfowl, wild turkey, gray and fox squirrel, rabbit, snowshoe hare, ruffed grouse and raccoon. As discussed in Chapter 2, in 1996, individuals took 9,230 trips to the NNWR to hunt.[5] The majority of these trips were taken for hunting big game species. In 1996, individuals participated in approximately 6,000 big game hunting trips, 2,000 small game hunting trips, and 1,000 migratory bird and waterfowl hunting trips at the Refuge. As noted in Chapters 2 and 3, these estimates of annual hunting days are fairly precise.

We draw estimates of the welfare value of hunting days/trips from the economic literature, focusing on studies that provide estimates of the welfare value of a hunting trip or day at sites near the NNWR (e.g., studies analyzing Wisconsin hunting opportunities). Where necessary, we expand our literature review to include studies of more distant regions that provide values for species found in the study area.

The literature values we apply represent total consumer surplus values per day or per trip for hunting opportunities in Wisconsin, other states, and, when site-specific studies were unavailable, for the U.S. The values range from $14 to $167 (1996$) per hunting day, and from $20 to $38 per hunting trip. This range reflects not only the differences in the species values, but also in factors such as the characteristics of the hunters surveyed, the availability of alternative sites, the quality of the hunting experience, and the methods used to derive the value estimates.

To reflect the uncertainty in the welfare value estimates, we provide a range of values for the four types of hunting activities at the NNWR. Below we summarize the value estimates we use to estimate welfare, and Exhibit 5-1 presents the value estimates from the studies we used to develop our estimate ranges.

- **Big Game Hunting:** As indicated in Exhibit 5-1, big game hunting welfare value estimates range from $35 to $167 per day. In our analysis we develop upper and lower bound estimates from the studies estimating

[5] RMIS, 1996

Exhibit 5-1

SUMMARY OF HUNTING VALUE ESTIMATES

Game	Author (date)	Study Location	Species	Value (1996$)
Big Game	Waddington, Boyle and Cooper (1994)	Wisconsin	Deer	$35.12 per day
	Hay (1988)	Wisconsin	Deer	$44.99 per day
	Bergstrom and Cordell (1991)	U. S.	Big Game	$38.42 per trip
	Walsh, Johnson and McKean (1990)	U. S.	Big Game	$60.31 per day
	Brown, Charbonneau and Hay (1978)	U. S.	Big Game	$167.16 per day
Small Game	Bergstrom and Cordell (1991)	U. S.	Small Game	$20.98 per trip
	Walsh, Johnson and McKean (1990)	U. S.	Small Game	$40.88 per day
	Brown, Charbonneau and Hay (1978)	U. S.	Small Game	$54.85 per day
Waterfowl and Migratory Birds	Hay (1988)	Wisconsin	Waterfowl	$14.06 per day
	Charbonneau and Hay (1978)	Mississippi Flyway	Waterfowl	$46.21 per day
	Sorg and Nelson (1987)	Idaho	Waterfowl	$22.38 per trip
	Cooper and Loomis (1991)	San Joaquin Valley, CA	Waterfowl	$73.49 per day
	Walsh, Johnson and McKean (1990)	U. S.	Migratory Waterfowl	$47.27 per day
	Brown, Charbonneau and Hay (1978)	U. S.	Waterfowl	$86.19 per day

Wisconsin hunting values. U.S. FWS survey research provides the basis for the lower bound estimate of $35 per trip[6] and the upper bound estimate of $45 per trip.[7]

- **Small Game Hunting:** The range of small game hunting value estimates we use for this analysis represent values for the U.S. as a whole. We use a lower bound estimate of $21[8], and an upper bound estimate of $55.[9]

- **Waterfowl and Migratory Bird Hunting:** In many instances, the literature reports combined welfare value estimates for waterfowl and migratory bird hunting. As a result, we use the same range of value estimates for both types of hunting activities. The literature reports value estimates ranging from $14 to $86 per day; however, we focus on estimates most appropriate for Wisconsin. The lower bound value estimate of $14 per trip represents the value for waterfowl

[6] Waddington et al., 1994

[7] Hay, 1988

[8] Bergstrom and Cordell, 1991

[9] Walsh, Johnson and McKean, 1990

hunting opportunities in Wisconsin.[10] The upper bound value estimate of $47 per trip represents the per-trip estimates for hunting in the Mississippi flyway.[11]

To estimate hunting benefits in the NNWR, we use the participation day estimate for each type of hunting activity (using the RMIS data) and the associated range of literature value estimates for each hunting activity. Multiplying the upper and lower bound values by the total number of trips to the Refuge for each hunting activity yields annual benefits that range from $271,000 to $440,000 (1996$). Exhibit 5-2 presents these results. As shown, big game hunting activities are responsible for the majority of hunting benefits.

Exhibit 5-2

ESTIMATED ANNUAL ECONOMIC VALUE FOR HUNTING ON THE NECEDAH NATIONAL WILDLIFE REFUGE (1996$)

Activity	1996 Annual Trips	Welfare Estimate Per Trip		Annual Estimate of Value	
		Lower Bound	Upper Bound	Lower Bound	Upper Bound
Big Game	6,025	$35	$45	$211,000	$271,000
Small Game	2,200	$21	$55	$46,000	$121,000
Waterfowl	930	$14	$47	$13,000	$44,000
Migratory Birds	75	$14	$47	$1,000	$4,000
			Total:	**$271,000**	**$440,000**

Fishing

The NNWR offers a limited number of fishing opportunities to the public in designated waters at prescribed times. The most common species caught by recreational anglers are northern pike and bullhead. Black crappie, yellow perch and sunfish are also available, though less numerous. In 1996, individuals took over 7,000 sport fishing trips to the NNWR.[12]

We draw estimates of the value of fishing days/trips from the economic literature, focusing on studies that provide estimates of the value of a recreational fishing trip or day at Wisconsin sites. Where

[10] U.S. FWS, 1985

[11] U.S. FWS, 1978

[12] RMIS, 1996

necessary, we expanded our literature review to include studies of more distant regions that provide values for species found in the study area. Exhibit 5-3 presents the value estimates from the studies we used to develop our estimate range.

Exhibit 5-3

SUMMARY OF RECREATIONAL FISHING VALUES (1996$)

Author (date)	Study Location	Valued Species	Habitat/Fishing Type	Value Estimate
Lyke (1990)	WI	**Pike**, Panfish, Yellow Perch, Bass, Muskellunge, Salmon, Trout, Walleye	Inland Fishing	$167.73 per day
Mullen and Menz (1985)	NY	**Pike,** Perch, Bass, Sauger, Walleye, Other Warmwater and Coldwater	Lake	$49.87 per day
Connelly, Brown, Knuth (1988)	NY	**Bullhead**, Bass, Catfish, Yellow Perch, Walleye	Lake	$17.04 per day
		Yellow Perch, Bass, Walleye		$21.38 per day
		Pike, Bass, Lake Trout, Salmon, Yellow Perch, Walleye		$18.18 per day
		Pike, Lake Trout, Yellow Perch, Bass		$22.58 per day
		Bass, Lake Trout, Salmon, Yellow Perch		$31.84 per day
Dutta (1984)	OH	Yellow Perch, Walleye, White Bass	Lake and Great Lakes	$12.22-$25.94 per trip
Hushak, Winslow and Dutta (1989)	OH	Yellow Perch	Great Lakes	$5.08 per day
Charbonneau and Hay (1978)	U.S.	**Pike**, Walleye	Lake, River, Great Lakes	$80.97 per day
		Pike, Bass, Muskellunge, Walleye		$101.86 per day

The literature values we apply represent total consumer surplus values per day or per trip for angling opportunities in Wisconsin, other states providing similar fishing opportunities, and, when site-specific studies were unavailable, for the U.S. We develop a range of value estimates for the target species at the NNWR (i.e., pike and bullhead). We use a lower value of $17 per day which estimates the value of bullhead fishing,[13] and an upper value of $102 per day which estimates the value of pike fishing.[14] This range reflects not only the differences in the species values, but also in factors such as the characteristics of the anglers surveyed, the availability of alternative sites, the quality of the fishing experience, and the methods used to derive the value estimates. We do not include the Lyke (1990)

[13] Connelly, Brown and Knuth, 1988

[14] Charbonneau and Hay, 1978

study in our range of value estimates because this study values fishing for much more highly valued species (salmon, trout).

To estimate sport fishing benefits in the NNWR, we use the estimate of annual fishing trips to the Refuge and the associated range of literature values for each species. Multiplying the upper and lower bound values by the number of fishing trips yields annual benefits that range from $125,000 to $747,000. Exhibit 5-4 presents these results. As noted in Chapters 2 and 3, the estimate of annual fishing days is not as precise as the estimate of hunting days. As a result, final estimates of the value of NNWR fishing days should be interpreted with this uncertainty in mind.

Exhibit 5-4

ESTIMATED ANNUAL ECONOMIC VALUE FOR FISHING ON THE NECEDAH NATIONAL WILDLIFE REFUGE (1996$)

1996 Annual Trips	Welfare Estimate Per Trip		Annual Estimate of Value	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
7,325	$17	$102	$125,000	$747,000

Wildlife Viewing

The primary recreational activity at the NNWR is wildlife viewing. The Refuge provides viewing opportunities throughout the year. Though principally known as a wildlife sanctuary offering opportunities to view migratory waterfowl, visitors can also enjoy viewing other birds, including, but not limited to, bluebirds, swans, sandhill cranes, eagles, hawks, owls and songbirds. The Refuge also provides the opportunity to view large and small mammals such as white-tailed deer, beaver, raccoon, otter, gray and fox squirrels, and snowshoe hare. Visitors may also find turtles, snakes, butterflies and other plant and animal species in and near the various fields, forests, oak barrens and bodies of water that make up the NNWR.

As in the cases of hunting and fishing, we draw estimates of the value of wildlife viewing opportunities trips from the economic literature, focusing on studies that provide estimates of value at Wisconsin sites. Where necessary, we expanded our literature review to include studies of more distant regions that provide values for species found in the study area.

The literature values we apply represent total consumer surplus values per day or per trip for wildlife viewing opportunities in Wisconsin, other states, and, when site-specific studies were unavailable, for the U.S. The values range from $21 to $61 ($1996) per wildlife viewing day. This range reflects differences not only in the wildlife viewing species and activities (e.g., photographing, viewing), but also in factors such as the characteristics of the respondents surveyed, the availability of alternative sites, the quality of the wildlife viewing experience and the methods used to derive the value estimates. Exhibit 5-5 presents the results of our wildlife viewing literature search.

Exhibit 5-5

SUMMARY OF WILDLIFE VIEWING VALUES (1996$)

Author (date)	Location	Activity	Value
Hay (1988)	Wisconsin	Wildlife observation, photography, and feeding	$21.09 per day
Waddington, Boyle and Cooper (1994)	Wisconsin	Wildlife observation	$30.59 per day
Cooper and Loomis (1991)	San Joaquin Valley, CA	Birdwatching	$49.51 per trip
Walsh, Johnson and McKean (1990)	U. S.	Nonconsumptive use	$29.45 per day
Bergstrom and Cordell (1991)	U. S.	Wildlife observation	$61.16 per day

To estimate the value of wildlife viewing opportunities at the NNWR, we use per-day values from Waddington et al. (1994) and Hay (1988). Both of these studies provide value estimates for wildlife viewing opportunities in Wisconsin. We use Hay's wildlife observation value of $21 per day as the lower bound trip value, and the Waddinton et al. wildlife viewing estimate of $31 per day as the upper bound trip value. Multiplying these values by the total number of trips to the Refuge for wildlife viewing in 1996 yields annual benefits that range from $2.2 million to $3.3 million (1996$). Exhibit 5-6 presents these results. As noted in Chapters 2 an 3, the estimate of the annual number of NNWR wildlife viewing days is subject to significant uncertainty. Therefore, the estimates of the annual value of NNWR wildlife viewing should be interpreted with this uncertainty in mind.

Exhibit 5-6

ESTIMATED ANNUAL ECONOMIC VALUE FOR WILDLIFE VIEWING ON THE NECEDAH NATIONAL WILDLIFE REFUGE (1996$)

1996 Annual Trips	Welfare Estimate Per Trip		Annual Estimate of Value	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
106,835	$21	$31	$2,244,000	$3,312,000

Total Economic Value of NNWR Recreational Activities

The total annual economic value of the recreational activities at the Refuge ranges from $2.6 million to $4.5 million. As shown in Exhibit 5-7, the majority of these benefits are attributable to wildlife viewing values. This result is driven by the large number of activity days for wildlife viewing, despite small per-trip surplus values.

Exhibit 5-7

TOTAL ANNUAL ESTIMATED ECONOMIC VALUE FOR RECREATIONAL ACTIVITIES ON THE NECEDAH NATIONAL WILDLIFE REFUGE (1996$)

Activity	Lower Bound Estimate	Upper Bound Estimate
Hunting	$271,000	$440,000
Fishing	$125,000	$747,000
Wildlife Viewing	$2,244,000	$3,312,000
TOTAL	$2,640,000	$4,499,0 00

VALUE OF A RECREATIONAL ACRE

If the NNWR does expand by acquiring land in the YRFA, the regional economic costs associated with this expansion (as discussed in Chapter 4) would be accompanied by benefits associated with increased recreation. For example, as discussed in Chapter 4, the provision of additional wildlife habitat may lead to increased recreational visitation to the area, providing benefits to the regional economy. In addition, economic benefits may be incurred in the form of increased economic surplus enjoyed by individuals taking part in these new recreational opportunities. To obtain an order-of-magnitude estimate of the social welfare benefit that may accrue under an expansion scenario, we estimate the economic surplus per activity acre for the current Refuge. That is, we consider the surplus produced per acre of Refuge, by dividing the total estimated surplus by the number of acres of land that currently make up the Refuge. In Exhibit 5-4 we provide the low and high economic surplus values for the different recreational activities, as discussed above, and then convert the total surplus value for the existing Refuge to a per-acre estimate.

In performing this calculation we assume that any new lands added to the Refuge would provide similar economic benefit as that provided by the average acre of land on the existing Refuge. Specifically, our analysis assumes the following:[15]

- Fishing quality in the YRFA would be better than that provided by the existing Refuge because the Yellow River provides an abundance of backwater areas, small ponds and oxbow lakes.

- Hunting quality in the YRFA land would be similar to that provided by the existing Refuge lands.

[15] Most of this information was provided by NNWR management.

- Wildlife viewing quality would be equal to or greater than that of the existing Refuge. This is because of the unique habitats contained within the YRFA, not well represented on the existing Refuge.

- Access to recreational opportunities in the YRFA, including the manner in which these lands will be managed, will be similar to the existing Refuge.

- Lands within the YRFA would be managed in a similar manner to the existing Refuge.

This analysis implies that the value of a recreational acre in the YRFA is equal to or slightly better than an acre of land in the existing Refuge. As can be seen in Exhibit 5-8, the estimated value per acre ranges from a low of $61 to a high of $103.

Exhibit 5-8

VALUE OF A RECREATIONAL ACRE ON THE NECEDAH NATIONAL WILDLIFE REFUGE AND THE YRFA (1996$)

Activity	Low Value	High Value
Hunting	$271,000	$440,000
Fishing	$125,000	$747,000
Wildlife Viewing	$2,244,000	$3,312,000
Total Economic Surplus	$2,640,000	$4,499,000
Total Acres of Existing Refuge	43,655	43,655
Total Per-Acre Value	$60.50	$103.10

Note that this analysis ignores any recreational activity that currently takes place in the YRFA. If these lands are currently used for recreation, this analysis will overstate the social welfare gain that would result from acquisition. Similarly, if most of the recreation that would take place on this land simply represents trips substituted from the existing Refuge, the net social welfare benefit of the acquisition will be overstated by this analysis. Alternatively, the nature of these lands may make them more conducive to recreational activity than lands currently in the Refuge. In this case our analysis may understate the benefits of acquisition.

NONUSE AND ECOLOGICAL SERVICE VALUES

In addition to recreational and commercial values, individuals hold a value for natural resources independent of their use of those resources. This residual of total value is referred to as nonuse or existence value, a concept described at great length by Krutilla (1967) in his seminal piece, "Conservation Reconsidered." Krutilla suggests that "when the existence of a grand scenic wonder or a unique and fragile ecosystem is involved, its preservation and continued availability are a significant part

of the real income of many individuals."[16] For example, Freeman (1993) explains that people may gain utility from the knowledge that a natural area is preserved despite the fact that they do not expect to visit that area. Similarly, people may be willing to pay to protect endangered species even though they do not expect to see one of them. These values may be motivated by desires to maintain intergenerational equity and the option of future resource use, as well as other factors.[17]

For our purposes, we consider two related components of nonuse value associated with the NNWR. The Refuge renders an ecological service by providing vital habitat to several species, including some listed as federally endangered.[18] To estimate the value of this service we draw upon recent research and data that are suggestive of the value individuals place on endangered species preservation. Second, we estimate the value of the Refuge as a preserved natural area, relying upon existing valuation studies of areas with similar attributes.

Value of the Refuge as Endangered Species Habitat

The Refuge is an important habitat for several rare, uncommon and declining species. Species of state and federal concern include, but are not limited to the bald eagle, massasauga rattlesnake, Louisiana waterthrush, red-shouldered hawk, glass lizard, cerulean warbler, wood thrush, scarlet tanager, Blanding's turtle and blue-winged warbler. In addition, the Refuge accommodates oak and pine savannah and pine barren ecosystems, habitat critical to the endangered Karner blue butterfly.

To assess the value of the Refuge as an endangered species habitat, we consider two types of information: (1) expenditures made by federal and state agencies on two species present in the Refuge that are listed under the Endangered Species Act (the bald eagle and the Karner blue butterfly); (2) an existing summary of contingent valuation (CV) studies that elicit individuals' values for species preservation. While neither of these sources allows us to fully appreciate the value of the ecological services flowing from the Refuge, they do indicate the magnitude of the values individuals hold for wildlife preservation.

Public Expenditures on Endangered Species Preservation

Public policies designed to protect natural resources and public and private expenditures on preservation of endangered species and their habitats demonstrate that the public holds value for these resources. In enacting the Endangered Species Act, Congress asserted that threatened and endangered

[16] Krutilla, 1967, p. 779

[17] Freeman, 1993.

[18] The Refuge provides additional ecological services such as flood control, erosion prevention and filtration of toxic materials. The Refuge is in the process of developing a hydrogeologic profile of the area that would support an analysis of these services.

species "are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people."[19] In the last several years, federal and state agencies have appropriated significant funding for endangered species protection. Between the years 1989 and 1993 over $54 million was expended on behalf of the bald eagle, a species currently considered "secure" for both breeding and non-breeding populations. In those same years over $1.3 million was expended on behalf of the Karner blue butterfly, a species considered "imperiled" throughout its range.[20]

Although public expenditures indicate a willingness on behalf of society to make financial sacrifices to protect natural resources, they do not accurately represent the true value of those resources.[21] Federal and state governments have limited funds to allocate to many competing programs. As such, public expenditures may be influenced by the political process and efforts by special interest groups to achieve certain outcomes.[22] In addition, public expenditures do not account for the opportunity costs associated with forgone development, which in many cases may be significant.

Value of Endangered Species

For further evidence of the value of wildlife preservation we consider a recent summary and meta-analysis of the rare and endangered species valuation literature performed by Loomis and White (1996). The authors summarize several CV studies that provide willingness to pay values for preservation or augmentation of 18 different species. Two of these studies estimate values for the bald eagle.23 Because no welfare estimates exist for the Karner blue butterfly or other threatened species present in the Refuge, we discuss only the benefits associated with bald eagle preservation.

Boyle and Bishop (1987) estimate an annual willingness to pay of $17 (1996$) for bald eagle preservation by Wisconsin households. Similarly, Stevens et al. (1991) estimate an annual willingness to pay of $35 by New England households. To aggregate these individual benefits, we first identify the number of Wisconsin households that might maintain such values. Based on the survey area associated with the welfare estimates above, we apply our range of values to the total number of Wisconsin households. Currently, there are approximately 1.85 million

[19] Section 2 [16 USC 1531]

[20] This information is derived from an endangered species database compiled by Cash, et al. (1997).

[21] Freeman, 1993.

[22] Coursey, 1994.

[23] Boyle and Bishop, 1987; Stevens et al., 1991

households in the state of Wisconsin, yielding annual benefits of $31 to $65 million for bald eagle preservation services.[24] Since the role Necedah plays in overall preservation of the species is unknown, the proportion of this allocable to the Refuge is unknown.

To qualify these estimates, it is worth noting briefly some of the controversies associated with the contingent valuation method. Much of the concern over the reliability of CV estimates stems from two methodological consequences: (1) distortions that arise because of the hypothetical nature of CV questions; that is, the absence of real financial consequences, (2) biases introduced by "strategic incentives" (i.e., individuals may adjust their bids in an attempt to achieve certain outcomes).[25] As a result, many authors have investigated the convergence of CV estimates and results from simulated markets.[26] Recently, the concept of "calibration" has been examined as means to adjust for potential biases in CV estimates. For example, in 1994 the National Oceanic and Atmospheric Administration (NOAA) proposed a correction factor of 50 percent (i.e., estimates should be divided in two) for use in natural resource damage assessment.[27]

Because the art of contingent valuation is still maturing, we rely upon the more conservative estimates provided in the literature. It is likely that the aggregate benefits associated with bald eagle preservation provided by the Refuge is a fraction of the lower bound of the range presented above.

Existence Value of the NNWR

As discussed above, individuals may hold a value for the Refuge simply by virtue of its existence as a preserved and pristine area. To develop an estimate of existence value associated with the Refuge we identify three studies that attempt to estimate the preservation value of natural resources with similar attributes. The values provided in these studies are not directly transferable to the NNWR, largely because of dissimilarities in physical characteristics. In addition, some of the values may inadvertently contain a use value component. Regardless, the values are useful in determining the magnitude of the existence value associated with the Refuge. Exhibit 5-9 summarizes the values presented in these contingent valuation studies.

[24] Demographic information available on-line at *http://badger.state.wi.us/statewide.html*

[25] Smith, 1997.

[26] Refer to Loomis, et. al, 1996, for example.

[27] This adjustment was rescinded in the final 1996 regulations.

Exhibit 5-9

ESTIMATED RESOURCE VALUES RELEVANT TO THE NNWR FROM EXISTING CONTINGENT VALUATION LITERATURE

Authors (Date)	Site Location	Description of Commodity	Annual Willingness to Pay (WTP, 1996$)
Bishop and Boyle (1985)	Illinois Beach State Nature Preserve (IL)	WTP to ensure maintenance and/or protection of the nature preserve[1]	$32.33 per person
Walsh, Loomis and Gillman (1984)	Wilderness areas (CO)	WTP to protect current wilderness areas (non-recreational use)[2]	$25.40 per household
Gilbert (1994)	Parker River National Wildlife Refuge (MA)	WTP to ensure maintenance and/or protection of the refuge[3]	$26.26 per person

[1] Survey respondents were Illinois residents who had not visited the Preserve during the study period.
[2] Survey respondents were Colorado residents.
[3] Survey respondents were refuge visitors, 77 percent of which were Massachusetts residents.

Results reported by Bishop and Boyle (1985) suggest that residents in a given state need not be cognisant of certain natural resources to hold value for them. For example, the authors found that despite the fact that much of the sample was unaware of the location of the Illinois Beach State Park and that the park also contained a nature preserve, 77 percent of respondents indicated that maintenance of the preserve was at least somewhat important to them. For this reason, we apply these per unit estimates to the population of Wisconsin as a whole. Based on a current population estimate of persons 18 and older of 3,822,570, and the range of existence values described above, we estimate annual aggregate benefits to be in the range of $47 to $124 million.[28] The magnitude of these values indicates that individuals place significant value on preserved areas, and in particular nature preserves and refuges.

For reasons described in the previous section we prefer the more conservative estimate in the range above. If we were to carefully construct our own CV study in an attempt to elicit nonuse values for the NNWR by Wisconsin residents, we postulate that results would be near the lower end of this range (i.e., on the order of the low tens of millions of dollars).

[28] The per-household value provided in Walsh, Loomis and Gillman (1984) was converted to a per-person value by calculating the average number of persons per household. The resultant value was $12.33 (1996$).

SUMMARY

The NNWR fills an important role in the south-central Wisconsin area by offering a variety of recreational activities and opportunities. In this chapter we have developed a variety of estimates of the social welfare benefits that visitors to the NNWR enjoy. The results of this analysis are summarized as follows:

- The annual net surplus value for hunting on the NNWR ranges from $271,000 to $440,000 (1996$). The single most important category of hunting, in terms of total annual surplus, is big game hunting for deer.

- The annual net surplus value fishing on the NNWR ranges from $125,000 to $747,000.

- The annual net surplus wildlife viewing at the NNWR is between $2.2 million and $3.3 million.

- Based on these estimates, the total value of all economic surpluses generated by recreational activities that take place on the Refuge is between $2.6 million and $4.5 million. This is equivalent to $61 to $103 per acre of existing Refuge.

- Based on the value of recreational activities in the existing Refuge, the expected economic value associated with an added acre of Refuge land in the YRFA will be at least $61 to $103.

- In addition to recreational opportunities, the NNWR offers unique ecological services that have an economic value associated with them.

Appendix A

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